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FRIDAY, NOVEMBER 3, 1899.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE EARLY PRESIDENTS OF THE AMERICAN ASSOCIATION.**

I.

FOR a second time in its history the Section on Social and Economic Science in the American Association for the Advancement of Science has chosen for its presiding officer one whose early training was that of a chemist. It had been my hope to present before you an address that should treat of certain phases of the development of industrial chemistry in the United States. The suggestion, however, made at the mid-winter meeting in New York by Professor Putnam, that I prepare an account of the early history of the Association, appealed to me so strongly that I was very glad to yield to the wishes of the Council, who promptly accepted the recommendation of our distinguished President, and, therefore, I have the honor of addressing you on The Early Presidents of the American Association.

HISTORY.

The American Association for the Advancement of Science came into formal existence in the city of Philadelphia, on September 20, 1848. The prevalent fondness for genealogical research affords us an ex-

* Address of the Vice-President and Chairman of Section H—Anthropology—of the American Association for the Advancement of Science, Columbus, August 21, 1899.

cellent excuse for a brief discussion of its ancestry.*

For a century preceding the existence of our Association, Philadelphia had held foremost rank as a scientific center. It was in that city as early as 1743 that Benjamin Franklin, America's first great scientist, had made futile effort to form a society "of *virtuosi* or ingenious men residing in the different colonies to be called the American Philosophical Society."† That society, however, as is well known, did organize in 1769, and still survives, the oldest of scientific societies in the United States. An interesting evidence of the fact that Philadelphia was a Mecca to scientific men is the statement that Priestley, on his arrival in New York in June, 1794, declined to give a course of lectures in that city, and proceeded at once to Philadelphia, where he received a complimentary address from the American Philosophical Society.‡

In the early dawn of the new century came that wonderful development of science in New Haven, brought about by the influence of the elder Silliman, who, by the way, first studied chemistry in Philadelphia under James Woodhouse. In the year 1819, in the philosophical room of Yale College, there was organized the American Geological Society, of which, according to G. Brown Goode, our Association 'is essentially a revival and continuation.'§ "Its members," says the same authority, "following European usage, appended to their names the symbols 'M.A.G.S.,' and among these were many distinguished men, for at that time almost every one who studied any other branch of science, cultivated geology also."* If we accept the American Geological Society as our ancestor, it gives the American Association rank as the fifth oldest scientific body in the United States.

As knowledge grew and education advanced, the desire for frequent intercourse among men of science increased more and more, and in the rooms of the Franklin Institute in Philadelphia, on April 2, 1840, there was organized the Association of American Geologists. This society, which two years later became the Association of American Geologists and Naturalists, is officially recognized as our progenitor, and the record of the eight meetings is given in the preliminary pages of our annual volume of proceedings. Of the founders of that Association the venerable Martin H. Boyé still survives,† and in New York City, Oliver P. Hubbard, who served as its secretary in 1844, remains to us a living witness of the mighty events that have occurred in the golden era of science.

It will not be out of place, I am sure, to mention the influence of the National Institution for the promotion of science on the formation of our Association. It was that Institution, which in April, 1844, brought together in Washington City the first National Congress of scientific men—the first cosmopolitan assemblage of the kind which in any respect foreshadowed the great congresses of the American Association in later years.‡

* In *The Chautauquan*, Vol. XIII., p. 727, September, 1891, there is a historical sketch of The American Association for the Advancement of Science, by the present author, which may be of some interest to the student of the history of American science.

† The Origin of the National Scientific and Educational Institutions of the United States, by G. Brown Goode. Annual Report of the American Historical Association for the year 1889. Washington, 1890, p. 54.

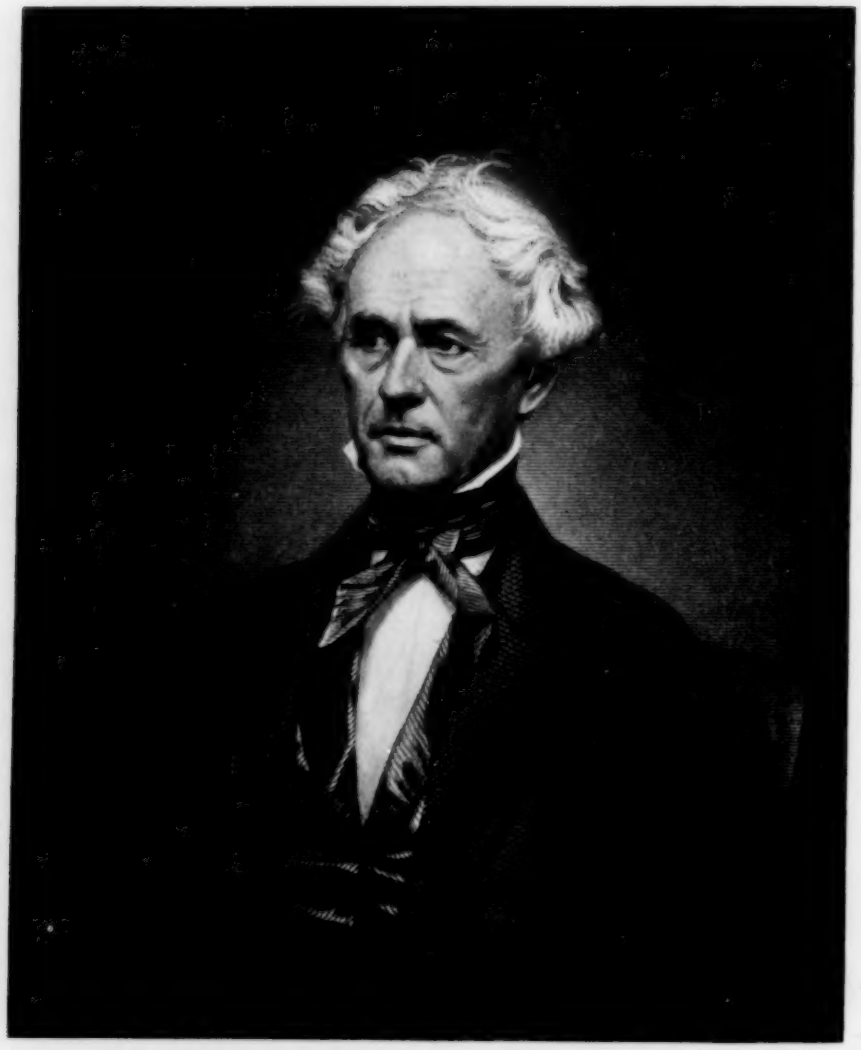
‡ The Development of Science in New York City, by Marcus Benjamin. Memorial History of the City of New York. New York, Vol. IV., p. 415.

§ Goode, op. cit., p. 112.

* Goode, op. cit., p. 112.

† The *Scientific American*, Vol. LXXIV., p. 430, for December 12, 1896, under the title of 'A Pioneer of Science,' gives an interesting account of Martin H. Boyé with a portrait.

‡ The First National Scientific Congress (Washington, April, 1844) and its connection with the organization of the American Association. Report U. S. National Museum, 1897 (in press).



WILLIAM C. REDFIELD.

This Institution, so successful that it was perhaps the most powerful "agency in setting in operation the influences which led to the establishment of the Smithsonian Institution, the National Observatory, the National Museum and the Department of Agriculture, and in later years, of the National Academy of Sciences," * yet so unsuccessful that "the Smithsonian fund, which it aspired to control, was placed under other authority; the collections and manuscripts of the United States Exploring Expeditions were removed from its custody; the magnificent collection in natural history, ethnology and geology, which had accumulated as a result of its wonderful activity and enthusiasm, soon became a burden and a source of danger," † was abandoned by its founders and supporters, and finally in 1861 went out of existence by the termination of its charter. Its remarkable history has been told by G. Brown Goode in a paper in which he showed its connection with the organization of our Association. In closing he said of the American Association:

> The new society was born, and it is significant that the name first adopted was as nearly as possible a combination of the names of the two societies. The one contributed the first half of the name, 'The American Association,' the other the second half—'for the Promotion of Science.' The word advancement in place of promotion was substituted afterwards. ‡

The history of the Association is a task that must be left for other, more competent members to present to you. To me has been assigned the duty of briefly reviewing the career of that brilliant galaxy of men who have been chosen by you to preside over the meetings of the American Association for the Advancement of Science.

* Idem.
† Idem.
‡ Goode, First National Scientific Congress.

REDFIELD.

William C Redfield "who was the first to suggest the idea of the American Association in its present comprehensive plan, and the first to preside over its deliberations,"* was born at Middletown, Conn., on March 26, 1789. As a boy he received only the simplest rudiments of education, and at the age of fourteen was apprenticed to a saddler. At that time he evinced a remarkable fondness for books, and, we are told, that "he was denied even a lamp for reading by night much of the time during his apprenticeship, and could command no better light than that of a common wood fire in the chimney corner."† Through the interest of Dr. William Tully, a learned and distinguished physician of Cromwell, Conn., he was accorded the privilege of that good doctor's library, and chose Sir Humphrey Davy's Elements of Chemistry with which to occupy his leisure moments. In returning the book he surprised its owner by showing a thorough acquaintance with its contents, and in particular with the doctrine of chemical equivalents, which, he said, he had then met with for the first time.

On the completion of his apprenticeship, early in 1810, he made a long journey on foot to Ohio, passing through New York and northern Ohio, when "the sites of Rochester and Cleveland were both dark and gloomy forests, and Buffalo was a mere hamlet."‡ He returned to New England in the following spring, choosing on this occasion a more southerly route, through parts of Virginia, Maryland and Pennsylvania. This journey deserves special mention because it

* Address on the Scientific Life and Labors of William C Redfield, A.M., first President for the American Association for the Advancement of Science, delivered before the Association at their annual meeting in Montreal, August 14, 1857. By Denison Olmsted, with an engraved portrait on steel. Cambridge, 1858, p. 3.
† Idem, p. 5.
‡ Idem, p. 7.

was from the observations made by him then that he was able later to advocate with such remarkable power the great superiority of railroads to canals, and also the plan of a system of railroads connecting the waters of the Hudson with those of the Mississippi. In a pamphlet, which he issued in 1829, he startled the community by the boldness of his project. He says, referring to the territory east of the Mississippi:

> This great plateau will, indeed, one day be intersected by thousands of miles of railroad communications; and so rapid will be the increase of its population and resources, that many persons now living will probably see most or all of this accomplished.*

To the scientific world Redfield, however, is best known by his development of the law of storms. Essentially his theory was that a storm was a progressive whirlwind. For years he kept his theory to himself, and it was not till accumulative evidence established in his own mind the correctness of his convictions that he gave to the world, through the *American Journal of Science*, his valuable series of papers on that science which we now dignify by the name of meteorology.

Through the long years of his life Mr. Redfield was actively engaged in business, having established a line of two barges between New York City and Albany, and it was only such time as could be spared from more important pursuits that he devoted to the higher cause of science. The fossils, the ripple marks and the rain-drops in the sandstones of Connecticut and New Jersey interested him, and the papers which he read before this Association towards the close of his career pertained to his studies in geology. He died in New York City on July 12, 1857.

HENRY.

The selection of Joseph Henry, in 1846, to be the guiding hand of the then newly established Smithsonian Institution, made him, perhaps the most conspicuous representative of American science of his time. Henry was born in Albany just a century ago, and there he grew up and was educated. As a student, as a teacher, and as a professor, he was connected with the Albany Academy, and in that institution he carried on those researches in electricity which made the electromagnetic telegraph of Morse possible. In other words, Henry was the first to construct and use an electromagnetic acoustic telegraph of a type similar to that which is at present more generally employed than any other form. The code of signals now in general use had not at that time been invented.* In referring to his researches Sir David Brewster says: "On the shoulders of young Henry has fallen the mantle of Franklin."† In 1832 he accepted a call to the chair of natural philosophy, in Princeton, and for fourteen years led the peaceful life of a college professor in a rural university town.

Then came the call to Washington, and dubious as to the future, he said: "If I go I shall probably exchange permanent fame for transient reputation."‡ The path of duty was clearly defined, and yielding to the solicitation of his associates, such as Bache, Hare and Silliman, he accepted the appointment of secretary of the Smithsonian Institution. Of his career in Washington a contemporary says:

> Called to administer the Smithsonian trust, his conscientious devotion gave it from the first the direction designed by the testator. His aim was to originate and disseminate. He scattered the seed broadcast, not through whim or favoritism, but on a matured plan. His

* Route of a Great Western Railway, 1829.

* Sketch of Joseph Henry, by G. Brown Goode, in The History of the First Half Century of the Smithsonian Institution. Washington, 1897, p. 134.

† Idem, p. 122.

‡ A Memorial of Joseph Henry, with an engraved portrait on steel. Washington, 1880, p. 276. Discourse of William B. Taylor.

place required a love of science, along with a talent for organization. He brought these to bear upon the origination of knowledge, and by his scientific sympathy and ready recognition of others of his guild, he commanded honest homage and became the director, helper, and umpire in scientific disputation. Did the War Department require his aid in meteorology? He gave the plan of weather signals. Did the Census Bureau ask his help? He planned the remarkable atlas as to rain-falls and temperature. Did the Coast Survey require scientific suggestions, or the Centennial Commissioners his judgment, or the new library and the 'School of Art' a friend and adviser; or the Light House board laws of sound for fogs, and cheaper and better illumination? He freely gave what was gladly welcomed. His institution gave Agassiz opportunity to study fishes, Baird, birds, and all students encouragement to investigate our American archæology and ethnology, as well as our fauna and flora.*

Those who are willing to know more of Henry's great work need only consult The Memorial Volume,† published by the Smithsonian Institution shortly after his death. I add the last sentences of Goode's sketch of him, which was published in the History of the First Half Century of the Smithsonian Institution:

> What Franklin was to the last century, Henry is to this, and as the years go by his fame is growing brighter. The memorial service in his honor, held in 1878, in the hall of the United States House of Representatives, was a national event. In 1883 his monument in bronze, by the greatest of American sculptors, was erected by Congress in the Smithsonian Park. The bestowal of his name upon the unit of induction in 1893 was an indication of his foreign appreciation, while, as a still nobler tribute to his fame, his statue has been placed under the great rotunda of the National Library, the science of the world and of all time being symbolized by these two great men, Newton and Henry.‡

Beginning with 1850 the Association inaugurated the custom of holding a meeting in the spring of the year as well as one in the late summer. These earlier gatherings were held in the cities of the south and west, and the first of them, in March, 1850, was convened in Charleston, South Carolina, then a city of much scientific activity. Over this meeting Alexander Dallas Bache was chosen to preside.

BACHE.

Birth, education, and association combined to qualify Bache in an unusual degree for the many important duties to which he was called. He was the son of Richard Bache, one of the eight children of Sarah, the only daughter of Benjamin Franklin, and was born in Philadelphia in 1806. He was educated at the United States Military Academy in West Point and graduated at the head of the class of 1825 (of which he was the youngest member), with the unusual distinction of completing that rigid course of four years without receiving a single demerit. An appointment in the Corps of Engineers followed, and after serving a year as assistant professor of engineering at West Point, he was assigned to duty under Colonel Joseph G. Totten, in Newport, Rhode Island.

In 1829 he resigned from the army to accept the chair of natural philosophy and chemistry in the University of Pennsylvania, in Philadelphia, where he remained until 1843, leading a life of great activity, for he was a guiding influence in nearly every scientific movement in the city of his birth. He was appointed chairman of one of the most important of the committees of the Franklin Institute, and was chosen as the expounder of the principles of the Institute at its public exhibitions. He was an active member of the American Philo-

* Idem, p. 103. Address of Hon. S. S. Cox.

† A Memorial of Joseph Henry, Washington, 1880.

‡ The Smithsonian Institution, 1846–1896. The History of its First Half Century, Washington, 1897, p. 156.

sophical Society, and in his private observatory began that series of magnetic observations with which his name is so honorably connected.

His services in establishing the Girard College, of which he was the first president, and his development of the public school system of Philadelphia while filling the offices of principal of the high school and that of superintendent of the public schools, are best described in the statement that "the result of his labors in regard to the schools was the establishment of the best system of combined free education which had, at that time, been adopted in this country. It has since generally been regarded as a model, and has been introduced as such in different cities of the Union." *

Bache's great work, however, was in connection with the United States Coast Survey, to the superintendency of which he was called in 1843, and of his relation to that work I again quote from his biographer:

When Professor Bache took charge of the survey, it was still almost in its incipient stage, subjected to misapprehension, assailed by unjust prejudice, and liable, during any session of Congress, to be suspended or abolished. When he died, it had conquered prejudice, silenced opposition, and become established on a firm foundation as one of the permanent bureaus of the executive government. * * * He divided the whole coast line into sections, and organized, under separate parties, the essential operations of the survey simultaneously in each. He commenced the exploration of the Gulf Stream, and at the same time projected a series of observations on the tides, on the magnetism of the earth, and the direction of the winds at different seasons of the year. He also instituted a succession of researches in regard to the bottom of the ocean within soundings, and the forms of animal life which are found there, thus offering new and unexpected indications to the navigator. He pressed into service, for the determination of the longitude, the electric telegraph; for the ready production of charts, photography; and for multiplying copper-plate engravings, the new art of electrotyping. In planning and directing the execution of these varied improvements, which exacted so much comprehensiveness in design and minuteness in detail, Professor Bache was entirely successful.*

In Washington, as in Philadelphia, he was foremost in every movement, public or private, that tended towards the advancement of science. Besides being *ex-officio* superintendent of Weights and Measures, he was a member of the Lighthouse Board, and a regent of the Smithsonian Institution from its inception till his death. Nor can I omit mention of the fact that he was a Vice-President of the United States Sanitary Commission, and first President of the National Academy of Sciences. Professor Bache presided over the Charleston meeting in 1850, and also over the New Haven meeting in August, 1851, and over the Cincinnati meeting in May of the same year.

It is difficult at this time to determine when the unwritten law of the Association that a representative of the natural sciences should be chosen to succeed a representative of the physical sciences in the presidential chair came into existence, but with the election of Louis Agassiz, in 1851, as the successor of Bache, the principle was clearly indicated.

AGASSIZ.

With the possible exception of the elder Silliman, the influence of Louis Agassiz on the development of science in our country has been greater than that of any other single man. The extraordinary personal qualities of character as well as the talents and attainments of this great naturalist

* Eulogy on Professor Alexander Dallas Bache, late Superintendent of the U. S. Coast Survey, by Joseph Henry. Smithsonian Report for 1870, p. 98.

* Henry's Eulogy on Professor Alexander Dallas Bache, pp. 100, 101.

make any attempt of a brief sketch of his career almost impossible. *

The son of a Protestant clergyman, he was born in Switzerland, in 1807, and his early academic education was obtained in Bienne, Lausanne and Zurich, whence he passed to the great German universities of Heidelberg, Munich and Erlangen. Even in those days he was a leader. In Munich he was the presiding officer of the Little Academy, the members of which have since enrolled their names high on the tablets of fame. At the age of twenty-one, even before the doctor's degree had been conferred upon him, young Agassiz had secured 'a place among the best naturalists of the day' † by his work on the fishes of Brazil.

Delightful years in Vienna and Paris followed during which his dissipations were confined to the pleasures of association with the most distinguished men of his time, especially in Paris, where Humboldt was a conspicuous leader, and became his patron. Then, in 1832, he settled in Neuchatel as professor of natural history in the small college of that ever-charming little city. Students came to him; and among his associates of that time were Guyot and Pourtales, whom even the ocean could not separate from him. His 'Recherches sur les Poissons fossiles' in five quarto volumes, and his 'Etudes sur les Glaciers,' were given to the world during his residence in Neuchatel. The former is perhaps his most important contribution to natural science, and the latter a pioneer work in glacialogy.

In 1840 an invitation to deliver a course of lectures before the Lowell Institute in Boston was obtained for him through the interest of his friend, Sir Charles Lyell, and he agreed with Mr. John A. Lowell to give a course of lectures on the 'Plan of the Creation, especially in the Animal Kingdom.' He arrived in Boston in October, and in December delivered his first lecture. 'He carried his audience captive.'* From that time the well-worn 'Veni, Vidi, Vici' tells the story of his career in the new world. Enthusiastic audiences greeted him in New York, Philadelphia, Charleston, and elsewhere, and, yielding to the irresistible opportunities offered to him, he severed the ties that bound him to the land of his birth and accepted the chair of zoology and geology in the Lawrence Scientific School.

Guyot, his friend from boyhood, in speaking of the immense power he exerted in this country in spreading the taste for natural science and elevating the standard, says:

> How many leading students of nature are found to call themselves his pupils and gratefully acknowledge their great indebtedness to his judicious training? How many who now occupy scientific chairs in our public institutions multiply his influence by inculcating his methods, thus rendering future success sure.†

No better evidence of his success as a teacher is needed than that of the mere mention of his famous students. In addition to his son, Alexander, the names of Bickmore, Brooks, Clark, Fewkes, Hartt, Hyatt, Lyman, Morse, Niles, Packard, Putnam, Scudder, Shaler, Stimpson, Verrill, and Wilder, come readily to mind.

In this connection I want to quote from a letter of one of his students‡ who wrote me concerning his teaching as follows:

> The ideal of a young scientific student, and of every great teacher, is a devotion to scien-

* See Louis Agassiz. His Life and Correspondence, edited by Elizabeth Cary Agassiz, with portraits on steel, 2 vols. Boston, 1885.

† Biographical Memoirs of the National Academy of Sciences, Washington, 1886. Vol. II., p. 49. Louis Agassiz, by Arnold Guyot.

* 'Life and Correspondence,' Vol. II., p. 496.

† Memoir by Guyot, p. 71.

‡ Dr. J. Walter Fewkes.

tific research for its own sake. Agassiz had that ideal extraordinarily developed, and on that account the student was drawn to him and felt in a corresponding degree a great influence on his life. Agassiz made many and important contributions to science, but the greatest of all was a life which embodied the ideal that scientific research is an unselfish study of truth for truth's sake. Every student who was brought in contact with Agassiz recognized this ideal, and was profoundly influenced by it.

The museum of Comparative Zoology in Cambridge, is his most conspicuous monument, but his influence, more powerful than bricks or mortar, will live forever.

A boulder from the glacier of the Aar marks his last resting place in Mount Auburn, and so 'the land of his birth and the land of his adoption are united in this grave.'*

The policy of holding two meetings a year was soon found to be unsatisfactory, and it was abandoned after the Charleston meeting in 1851. In consequence no spring gathering was held in 1852, and also no summer meeting was held during that year. It was not until July, 1853, that the Association again met, and then it was convened in Cleveland under the presidency of Benjamin Peirce.†

PEIRCE.

This distinguished mathematician, one of the greatest this country has ever known, was born in Salem, Massachusetts, in 1810. His father, whose name the son inherited, is best remembered as the historian and librarian of Harvard. In Cambridge the boy grew to manhood, and was graduated at Harvard in 1829 in the class that Oliver Wendell Holmes has so beautifully immortalized in one of his charming poems.

While in college he became a pupil of Nathaniel Bowditch, 'who made the prediction that young Peirce would become one of the leading mathematicians of this century.'* After graduating he began his career as a teacher and in 1831 returned to his *alma mater* as tutor in mathematics, becoming eleven years later Perkins professor of mathematics and astronomy, which chair he held until his death, 'when he had been connected with the university for a longer time than any other person except Henry Flynt, of the class of 1693.'†

His election to the presidency of our Association was probably a result of his connection with the United States Coast Survey, as in 1852 he had been assigned to the charge of the longitude determinations in that service. The successful prosecution of that work, in which he was associated with some of our most distinguished members, indicated him as the natural successor to the superintendency of the Survey itself on the death of Bache in 1867.

The paramount events of the civil war had, to a large extent, interfered with the regular work of the Survey, but under Peirce it was actively resumed. The plans laid down by his predecessor were taken up and the Survey extended to a great geodetic system, stretching from ocean to ocean, thus laying the foundations for a general map of the country that should be entirely independent of detached local surveys. With this object the great diagonal arc was extended from the vicinity of Washington to the southward and westward along the Blue Ridge, eventually reaching the Gulf of Mexico near Mobile. He also planned the important work of measuring the arc of the parallel of 39 degrees to join the Atlantic and Pacific systems of triangulation; and for determining geographical positions

* Life and Correspondence, Vol. 2, p. 783.

† See Benjamin Peirce. A Memorial Collection, by Moses King, Cambridge, 1881, p. 18, with an engraved portrait on wood.

* Cyclopedia of American Biography, Vol. VI., p. 701 New York, 1888. Article on Benjamin Peirce written by myself.

† Memorial Collection.

in States where geological or geographical surveys were in progress.

Only an astronomer can follow the mathematical intricacies of Peirce's remarkable announcement concerning the discovery of the planet Neptune.

> This Planet [says President Hill] was discovered in September, 1846, in consequence of the request of Leverrier to Galle that he should search the zodiac in the neighborhood of longitude 325°, for a theoretical cause of certain perturbations of Uranus. But Peirce showed that the discovery was a happy accident; not that Leverrier's calculations had not been exact, and wonderfully laborious, and deserving of the highest honor, but because there were, in fact, two very different solutions of the perturbations of Uranus possible: Leverrier had correctly calculated one, but the actual planet in the sky solved the other; and the actual planet and Leverrier's ideal one lay in the same direction from the earth only in 1846. Peirce's labors upon this problem, while showing him to be the peer of any astronomer, were in no way directed against Leverrier's fame as a mathematician; on the contrary, he testified in the strongest manner that he had examined and verified Leverrier's labors sufficiently to establish their marvellous accuracy and minuteness, as well as their herculean amount.*

His greatest contribution to astronomy, however, was in connection with the rings of Saturn. He demonstrated that the rings, if fluid, could not be sustained by the planet, that satellites could not sustain a solid ring, but that sufficiently large and numerous satellites could sustain a fluid ring, and that the actual satellites of Saturn were sufficient for that purpose.

Peirce was a teacher, and his teaching is referred to by one of his students as 'the most stimulating intellectual influence I ever encountered.'† As an executive officer in charge of the coast survey, and also of the *American Ephemeris*, it is said that:

> The reports of that survey and the tables of the *Ephemeris* have rapidly raised the scientific reputation of America, which, in 1843, stood in astronomy among the lowest of civilized nations, and is now among the highest—a change which was by no means ungrateful to Peirce's strongly patriotic feeling, and which he could not but know was as much due to himself as to any other person.*

As a mathematician it was said at the time of his death that "the late Professor Peirce's merits will rank with the marvellous achievements of Bernoulli, Euler, and Laplace."†

President Hill closes his sketch of Peirce with the following words:

> While Professor Peirce has the tenacity of grasp, and power of endurance, which enable him to make the most intricate and tedious numerical computations, he is still more distinguished by intensity and fervor of action in every part of his nature, an enthusiasm for whatever is noble and beautiful in the world or in art, in fiction or real life; an exalted moral strength and purity; a glowing imagination which soars into the seventh heavens; an insight and a keenness of external observations which makes the atom as grand to him as a planet; a depth of reverence which exalts him while he abases himself. ‡

I prefer the stanzas of Holmes' Memorial poem, beginning with:

> To him the wandering stars revealed
> The secrets in their cradle sealed;
> The far-off, frozen sphere that swings
> Through ether, zoned with lucid rings;
>
> The orb that rolls in dim eclipse,
> Wide wheeling round its long ellipse,—
> His name Urania writes with these,
> And stamps it on her Pleiades. §

It was at the Toronto meeting just ten years ago that the Association was honored

* Thomas Hill in The Memorial Collection, p. 8.

† Thomas Wentworth Higginson, in The Memorial Collection, p. 31.

* *The Nation*, New York, October 14, 1880.

† *Boston Daily Advertiser*, October 7, 1880.

‡ The Memorial Collection, p. 11.

§ *Atlantic Monthly.*

by the presence of its then oldest living past president in the person of James Dwight Dana, who in 1854, presided over the meeting held in Washington.

DANA.

Dana was born in Utica, New York, in February, 1813, and as a boy showed a taste for natural science, making frequent excursions after minerals with his school companions. Attracted by the name of the elder Silliman, then at the height of his powers and reputation, he went to New Haven and entered Yale. As an undergraduate it is said that 'he made much progress in science, especially in his favorite study of mineralogy.'*

The influence of the master was irresistible, and he decided to devote himself to science, and, as if to confirm his decision, an opportunity presented itself even before he had graduated, for in 1833 he accepted an appointment as instructor in mathematics in the United States Navy. For more than a year he cruised in European waters, chiefly on the Mediterranean, devoting his leisure to studies of the interesting features of geology and natural history that presented themselves.

He returned to New Haven in 1836, and became an assistant to Silliman. It was at this time, in May, 1837, that he published the first edition of his System of Mineralogy. Scarcely had that work been given to the public than he received an invitation to become the mineralogist and geologist of the United States Exploring Expedition, about to visit the Southern and Pacific Oceans under Captain Charles Wilkes. In August, 1838, the expedition started from Norfolk, Virginia, and reached New York on its return in June, 1842. For thirteen years thereafter Dana devoted himself to the study of the material that had been collected, and to the preparation of his reports, of which those on the Zoophytes, the geology of the Pacific, and on the Crustacea were published.

Meanwhile he accepted the appointment to the Silliman chair of natural history and geology in Yale, but did not assume the active duties of the professorship until 1855.

From this auspicious beginning his active connection with Yale continued until it was interrupted in 1890 by a serious illness, after which, failing strength and advancing years made it impossible for him to resume his professorial duties, and in 1894 he was made professor emeritus.

The year 1818 is conspicuous in the history of the development of science in this country by the founding of the *American Journal of Science*. From its inception until his death the name of Benjamin Silliman appeared on its title-page as senior editor. In 1846 to that name was added that of the younger Silliman and Dana as associate editors. Of these three Dana was the survivor, and from 1875 till his death he was its senior editor.

In 1893, on the occasion of his eightieth birthday, a congratulatory letter from his scientific colleagues in New Haven made mention of his editorial career as follows:

> The long series of volumes of this periodical are a noble monument of the extent and thoroughness of your labors as a naturalist.*

It is fortunate for American science that this journal has been handed down as a precious legacy to the grandson of its founder, Edward S. Dana, under whose able guidance, let us hope, that it may long continue.

Wherever mineralogy or geology is taught, the unsurpassed text-books on these subjects by Dana, hold easy supremacy. His

*See James Dwight Dana, a biographical sketch, with a half-tone portrait, and bibliography, by E. S. Dana in the *American Journal of Science*, third series, Vol. XLIX., p, 329, May, 1895.

*Science, New Series, Vol. I., p. 489; May 3, 1895.

System of Mineralogy, first published in 1837 as a volume of 580 pages, passed to a second edition in 1844, a third in 1850, a fourth in 1854, and a fifth in 1866, when it had increased to 827 pages. The later editions were prepared by his son. To these must be added four editions of his smaller Manual of Mineralogy, the last of which appeared in 1887, and was a duodecimo volume of 518 pages. Of his mineralogy, Powell says:

> Thus he was the first to give us a system of mineralogy; but his work in this field did not end at that stage. He still pursued his investigations, collecting from many fields and drawing from the collections of many others in many lands, until at last he developed a new system of mineralogy, placing the science on an enduring basis. This accomplishment alone was also worthy of a great man, and by it a new science was organized on a mathematical, chemical and physical basis.*

The broader field of geology became his after his return from the exploring expedition, and he published his Manual of Geology in 1862. Of this work one of his colleagues says:

> The treatment of strata and fossils from a chronological point of view as historical geology is a characteristic feature of this manual. The growth and development of the earth, its continents and seas, and the progress in the organic life on its surface, were thus unified into a special department of geology, the history of the earth and of its inhabitants, which was by other authors dealt with as formational, stratigraphic, or paleontologic geology.

He prepared four editions of this work, the last of which appeared early in 1895, shortly before his death. As with his mineralogy he prepared an elementary textbook of geology, of which two editions were published. Concerning his valuable work on geology, Powell said:

> So Dana's Geology is not only a text-book of geology, but it is the hand-book for all National, State and local geologists, and all students in the field. It is the universal book of reference in that department of science. Other text-books have been developed but no other hand-book for America. It is a vast repository of facts, but all arranged in such a manner as to constitute a geologic philosophy. It is on every worker's table and is carried in the kit of every field observer. It has thus become the standard to which all scientific research is referred, and on which geologic reports are modeled.*

Besides the foregoing, Dana was the author of Coral Reefs and Islands, which he enlarged and published later as Corals and Corals Islands; of The Geological Story Briefly Told; The Characteristics of Volcanoes; and The Four Rocks of the New Haven Region.

In conclusion Powell says of him:

> Dana as a zoologist was great, Dana as a mineralogist was greater, but Dana as a geologist was greatest, and Dana in all three was a a philosopher; hence, Dana's great work is enduring.†

The ninth meeting of the American Association was held in Providence, Rhode Island, and over that meeting John Torrey, 'chief of American botanists,'‡ presided.

TORREY.

Torrey was born in New York City in 1796, and was the son of Captain William Torrey, of the Continental army, from whom he inherited the much-prized eagle

* Memorial address on James Dwight Dana before the Scientific Societies of Washington, by John W. Powell, SCIENCE, New Series, Vol. III., February 7, 1896, p. 183.

* Powell, op. cit., p. 184.

† Idem, p. 184.

‡ Biographical Memoirs of the National Academy of Sciences, Washington, 1886, Vol. II., p. 267. John Torrey, by Asa Gray. In addition to the foregoing a sketch of Torrey accompanied by an engraved portrait on wood is contained in the *Popular Science Monthly*, Vol. III., p. 632. Also his portrait can be found in a History of the New York Academy of Science, by Herman Leroy Fairchild, New York, 1887.

of Cincinnati. His mother was also of an old New York family. The boy was educated in his native city, and from Amos Eaton he learned 'the structure of flowers and the rudiments of botany.'* An education must have a broadening influence, and as he grew in years his interest in botany extended to chemistry and mineralogy, and finally to medicine, in which he was graduated from the College of Physicians and Surgeons in 1818. The practice of his chosen profession was not altogether congenial to him, and turning again to botany he began his Flora of the Northern and Middle United States. He published a portion of this work in 1824, and then accepted an appointment as assistant surgeon in the United States Army in order to become professor of chemistry, mineralogy, and geology in the United States Military Academy at West Point.

His abilities as a teacher received ample recognition, for in 1827 he was called to the chair of chemistry and botany in the College of Physicians and Surgeons, which he held until 1855. In 1830 he accepted the professorship in chemistry in Princeton, which he retained until 1854. These various collegiate appointments were then made *emeritus*, for on the establishment of the United States Assay Office in New York, in 1853, he was called to the charge of that place and held it until his death, twenty years later.

Gray says:

> It must not be forgotten that he was for more than thirty years an active and distinguished teacher, mainly of chemistry, and in more than one institution at the same time; that he devoted much time and remarkable skill and judgment to the practical applications of chemistry, in which his counsels were constantly sought and too generously given.†

The foregoing quotation becomes especially significant when we remember that his botanical work, yet to be referred to, was accomplished in the intervals of his busy life. In 1836 he was appointed botanist to the State of New York, and in 1843 issued the two quarto volumes of which it has been so well said: "No other state of the Union has produced a flora to compare with this."* Prior to the organization of the special scientific bureaus in Washington, with their large staffs of competent specialists, it was the practice of the government to refer the material collected by exploring expeditions to those most competent to report on it, and the botany in those years for the most part was assigned to Torrey. He reported on the specimens collected by Captain John C. Frèmont in the expedition to the Rocky Mountains in 1845; on the plants gathered by Major William H. Emory on the reconnaissance from Fort Leavenworth, Missouri, to San Diego, California, in 1848; on the specimen secured by Captain Howard Stansbury on his expedition to the Great Salt Lake of Utah, in 1852; on those collected by Colonel John C. Frèmont in California, in 1853; on those brought back from the Red River of Louisiana, by Captain Randolph B. Marcy, in 1853; and those obtained by Captain Lorenzo Sitgreaves on his expedition to the Zuñi and Colorado Rivers, in 1854. Then followed his elaborate memoirs on the botany of the various expeditions connected with the Pacific Railroad Survey during the years 1855–1860; the Mexican Boundary Survey in 1859, and the Colorado River Expedition in 1861. It was this succession of magnificent monographs on the flora of North America that gained for him an imperishable reputation among the greatest of American botanists.

His associates have honored his name by giving it to certain species of shade trees, and so all round the world *Torreya taxifolia*,

* Gray, op. cit., p. 268.

† Idem, p. 273.

* Idem, p. 271.

Torreya californica, Torreya nucifera, Torreya grandis preserve his memory as green as their own perpetual verdure.*

MARCUS BENJAMIN.

U. S. NATIONAL MUSEUM.

(To be continued.)

THE HISTORY OF THE BEGINNINGS OF THE SCIENCE OF PRE-HISTORIC ANTHROPOLOGY.

II.

Paleolithic Age in the United States.

The existence of the paleolithic stage of culture in America has been doubted, and, indeed, strenuously denied by some of our scientists who are well up in archeology and prehistoric anthropology.

My somewhat extensive travels with long stops and continuous examinations of many of the localities in Europe occupied by paleolithic man, especially among the caverns of the Dordogne district; my personal acquaintance with most of the collections of paleolithic implements made in these countries; my association with the leading investigators and believers in paleolithic occupation, have fitted me in a degree to judge of the subject which it would be mock modesty on my part to deny; while my dozen years' service in the prehistoric department of the U. S. National Museum, gives me an acquaintance with the American specimens by which I may compare the specimens from the two countries in a peculiar manner which I hope is not without its value.

The original discovery of a paleolithic period was made in Europe. The determining characteristics of that period have been decided only in Europe, and it must be principally by comparison with the evidence there that we are to determine the existence of a corresponding period in America. This evidence is furnished (in Europe) largely by geology and by paleontology. As has been described, discoveries of the remains of man, either physical or industrial (technologic), have been made in, and belong to, quaternary deposits, determined either by the geologic strata in which they were found, or the paleontologic objects with which they were associated. This species of evidence is, to a considerable extent, lacking in America. The European conditions have been found to exist in but few localities; yet America is not entirely without instances. Dr. Koch found a mammoth skeleton in Missouri, associated with which were flint weapons of human manufacture. It and the weapons are now displayed in the Berlin Museum. Dr. Dickeson found at Natchez, Mississippi, the buried skeletal remains of a megalonyx superposed on a portion of a human skeleton. The human skeleton from Guadeloupe, now at Paris, was encased in coquina, a rock made of shells belonging to the quaternary, though not exclusively so. The Iron Man of Sarasota Bay, Florida, found by Judge John G. Webb, was completely fossilized and changed to limonite. A fossilized human calcaneum was found by Col. Joseph Wilcox, of Philadelphia, in the same neighborhood with a quaternary shell forming part of the mass. Three similar instances were found in the same country in separated localities, showing them to have been different individuals; some of these have been encased in bog iron ore, others in indurated sandstone apparently as solid as though formed at the bottom of the ocean. The Nampa Image has been cited as evidence of high antiquity of man in America, and while its genuineness has been questioned, the attacks upon it are far from being successful.

The Calaveras skull has been the subject of much hilarious scientific criticism bordering on contempt. The facts of its discovery should be subjected to painstaking and detailed investigation before the results of

* Gray, op. cit., p. 276.

those facts are assumed. Whatever may be the conclusions concerning the fraudulent character of this specimen based upon its alleged 'planting' by contemporary miners, as a practical joke to 'fool Professor Whitney,' it should be remarked that the evidence favoring this charge is itself open to as grave suspicions as is the rankest fraud ever perpetrated. The geologic changes of that country have been so great, that it requires the gravest consideration and an intimate study or knowledge of all the facts before any one is justified in passing upon the archeologic question. I cannot here or now investigate the subject from either of these view points. I am not a geologist and I have never visited the locality. I can only suggest some of the points to be considered before a conclusion is reached, and raise a warning or danger flag to those who would decide against the authenticity of the specimen on insufficient or *a priori* grounds.

The Stanislaus river, at the time of the deposition of the lava and gravel in which the skull was found, ran down the side of Table mountain in the same neighborhood in which it now runs, but its valley was then some fifteen hundred feet higher than at present; that is, since the valley of the Stanislaus was choked up and the water turned aside by the eruption of lava and the deposit of cemented gravel, the deflected river has cut or eroded a new channel fifteen hundred or more feet deeper into the earth than was the earlier channel. This will give some idea of the immensity of time and the great surface changes with which we have to deal. Many implements and objects of undoubted human origin have been found in divers localities in California, alleged to have been imbedded in the same kind of gravels and to have formed part of similar deposits. It is part of the argument against the Calaveras skull to assail the authenticity of their discovery. First it was charged that these finds were made by miners, laymen, ignorant and unaccustomed to recognize or describe them with scientific accuracy; but this was answered when Professor Clarence King, then head of the Geological Survey of the United States, and the highest scientific authority, found one of the pestles *in situ*, imbedded in the cemented gravel under the lava cap, that he recognized its character before he exhumed it, and in view of the importance of the question involved, proceeded with care to dig it out. He preserved it, brought it to Washington, and placed it in its lawful depository, the U. S. National Museum, where it now is. It is remarkable that similar implements and objects to the number of about three hundred should have been found, alleged by their finders to have been dug out of the gravels under the lava cap in various localities in California—it is remarkable, I say that these should all have been frauds, and their finders either swindlers and liars, or else have duped themselves by their own discoveries. California miners have been generally credited with more astuteness than to be their own dupes, while it is curious if a whole state or a whole class within a state should combine in a general swindle and lie, out of which no profit, present or prospective, was possible. The objection has been made that these implements are polished or ground, at least pecked or hammered ready for polishing, therefore belong to the Neolithic or polished stone age; and this it is alleged is incompatible with their great antiquity. Some American archeologists assert that chipped stone implements were more difficult to make than polished ones, and on the well-recognized principle that the simplest and easiest way was the earliest, while the more complex and difficult ways came later, they insist with pertinacity that European classification is erroneous, and that the relative chronological positions

of the Paleolithic and Neolithic ages should be reversed. This view, if accepted, would satisfactorily explain the apparent anomaly of the California implements. The real answer to this objection is that we know but little concerning California prehistoric archeology. It presents many problems which have not been solved, nor indeed do we seem to be in the way of solving them. Some of these are as follows :

The Indian languages of the Pacific slope have peculiarities as yet unexplained. A A fringe of country lying between the coast range and the ocean contains a greater number of stocks or families of languages (29) than all the rest of North America combined.*

The reason for this has never been explained even theoretically or tentatively. The arrowpoints and spearheads of the Pacific Coast are notably different from those of other parts of the country. To such extent is this true that in my classification of these implements and weapons† I was compelled to make a separate class for the accommodation of the implements from this district. Pottery, forming the most serviceable, and which might be considered the most important, domestic utensils, and as such used by nearly all prehistoric and primitive peoples, makes complete default on the Pacific Coast; this, too, while their neighbors, the natives of Mexico and the Pueblo country, even the wild and savage Papagos, make and use it continually, some being of the largest forms with the finest decorations. Basketry in some cases supersedes pottery for carrying liquids, and the finest in America and perhaps in the world, either in ancient or modern times, are to be found on the California coast.‡

The ollas (carrying or cooking jars taking the place of pottery) are made of stone (serpentine) instead of clay. These are some of the California anomalies. When the problems presented by them have been satisfactorily solved, that relating to polished stone implements may not appear so difficult.

It has been objected that the stone implements of seemingly so high antiquity were not water worn and bore no traces of long or distant transportation by the mountain streams. An answer is patent. There is no evidence that they were transported or rolled any distance by water, and until this fact be established, there is no need to attempt the demonstration of its cause. We should establish the fact before we explain its cause.

The study of California archeology, in order that it be satisfactory, requires a union of three scientists: the archeologist, the geologist, and the historian who shall act as lawyer and judge. The Calaveras skull incident has closed, has passed into history, and its facts are to be determined by evidence, the same as any other fact in history. The first question is, did Mattison actually find the skull as he says he did? and second, had it been planted in order to 'fool Professor Whitney'? I think if this issue was made up to be tried before a court and jury on the lawful evidence submitted, the answers would be in the affirmative on the first question and negative as to the second. Until this issue is determined, it is folly to try the case by popular clamor and to denounce its possible believers or pour vials of contempt and contumely upon their heads.

Because I have favored the authenticity and genuineness of specimens which have been assailed, I would not have it understood that I am deluded into the belief that all specimens are genuine. I recognize that frauds have been committed, that

* See Major Powell's Linguistic Map; Seventh Annual Report of the Bureau of American Ethnology, 1885–86, pp. 7–142.

† Report of the U. S. National Museum, 1897.

‡ See the Hudson Collection just purchased by and now in the U. S. National Museum.

fraudulent specimens have been manufactured, planted, dug up and sold as genuine, and that great deceptions have been practiced. I have not hesitated to attack and destroy their claims whenever presented. But I here contend that in passing on the genuineness of specimens, we should decide fairly and honestly. We should first get possession of all the facts, sift them to their last residuum of truth, and, giving each fact its fair and due weight, decide the question according to our best and truest judgment. This should be done 'without prejudice or preconceived opinion.' It is unfair to decide such questions in advance of knowledge of the evidence; it is unscientific to decide *a priori* that so-and-so is true because it must be true, and so-and-so is not true because it can't be true. I heard one who claimed to be a prehistoric anthropologist say that he would not believe a certain object to be a genuine find if he had found it himself. It is obviously impossible to argue with, much less convince, such a man. In determining these contested questions, I have ever sought to be impartial and, above all things, honest. It is only thus that we can hope to arrive at the truth.

Boucher de Perthes's discovery of paleolithic implements in original and undisturbed quaternary river gravels has been described in its appropriate place in this address.

After the proposition that these were remains of human industry had been accepted, the European investigators drew deductions based on the similarity of objects and implements found in other localities where the geologic or paleontologic evidences were not so plain or so plentiful, and the finding of paleolithic implements alone has been accepted as evidence of human occupation during that period. The same practice has been pursued in America. The deposit at Trenton, New Jersey, is accepted by geologists as belonging to the quaternary period; and while the finding therein of paleolithic implements or human remains has been disputed, it seems to have occurred so often, and these finds to have been so numerous that it cannot long continue to be denied. The discovery of a mammoth tusk in the Trenton gravels, now on exhibition at Rutgers College, New Brunswick, N. J., is confirmatory evidence not to be overlooked or lightly regarded. I do not propose to enter into a discussion of the weather beaten subject of the Trenton gravels. I presented a paper before this section at the Detroit meeting,* by which I still stand. The same sort of evidence is furnished by the Tuscarawas specimen found by Mr. Mills in the glacial till of Ohio, and described by Professor Wright.† Likewise the implement found by Dr. Hilbourne T. Cresson, Delaware, and made the subject of a paper by Professor Wright, read before this Section at this meeting.

The chapter on High Plateau paleoliths deals with paleolithic chipped flint implements found in England on the surface; others of the same nature have been found, still on the surface, in France on the high plateaux between the rivers Seine and Yonne. These have been recognized by every one who is competent to have an opinion, as true paleoliths. The same condition applies to certain localities in the United States, that is to say, on the plateaux on the headwaters of certain rivers beyond the erosion by which the valleys were formed. So there have been found on the surface in the United States many chipped flint implements which from their size, shape, appearance and mode of manufacture, are identical to the smallest detail with the

* Published in Volume XLVI., 1897, pp. 381–383, of the Proceedings.

† *Popular Science Monthly*, July, 1891, Vol. XXXIX., No. 3, pp. 314–319. *Man and the Glacial period*, pp. 251–3.

recognized paleolithic implements of Europe. These are dissimilar to the prehistoric implements of every other period in any country, and if there is any force or truth in the argument of similarity of culture from, or by reason of, similarity of implements, between two widely separated peoples using them, this would seem to establish the existence of a paleolithic period in America as well as in Europe. Dr. Brinton and Professor Putnam, though occupying antagonistic positions on many of these questions, both seem to concede the antiquity of man on the American continent.

Dr. Brinton's address heretofore mentioned, contains two or three pregnant sentences on the subject of man's antiquity in America which, coming from him, are noticeable, and I quote them approvingly:

> There is, however, a class of monuments of much greater antiquity. * * * These are the artificial shell heaps which are found along the shores of both oceans and many rivers in both North and South America. They correspond to the kitchen middens of European archeology. * * * The shells are by no means all of modern type. Many are of species now wholly extinct, or extinct in the locality. This fact alone carries us back to an antiquity which must be numbered by many thousands of years before our era. * * * This class of monuments, therefore, supply us data which prove man's existence in America in what some call the diluvial, others the quaternary, and others again the pleistocene epoch, that characterized by the presence of extinct species.

Professor Putnam, in his address at this meeting said:

> That man was on the American Continent in quaternary times, and possibly still earlier, seems to me as certain as that he was in the Old World during the same period.

Antiquity of the Red Race in America.

Not to split hairs over names, I suppose we should all agree upon the generic name of 'Red Race,' and as I have some definite opinions as to the antiquity of the red race in America, I may make a *résumé* of my position.

If we accept the theory of the unity of the human species and its origin from a single stock, we must agree that the human species either originated on the Western Hemisphere and migrated to the Eastern, or else the reverse. Whether it originated in America or came here by migration, the conclusion seems irrefutable that it started with but comparatively few individuals, they occupied but one, or few localities, they grew to have practically the same industries, and they spoke practically the same language. Professor Putnam * contends that there was more than one race and so there may have been more than one migration and more than one colony. This, if accepted (and I make no dispute over it), does not materially affect my proposition. There were surely but few colonies with but few members in each. From these small beginnings, the red race had, prior to the discovery of America, spread over the entire Hemisphere, from the Arctic Ocean to Terra del Fuego, and from the Atlantic to the Pacific; it had increased, we can only suppose in the natural way, from a single pair or score or possibly a hundred individuals, to the seven or eleven millions which are said to have been the numbers at the time of Columbus's discovery; and their migrations had been sufficiently extended and the separation sufficiently pronounced and maintained, as that the language originally spoken had increased to the great number of which we now know.†

There is a difference or distinction in the ground or polished implements and objects of the ancient man of North America, which indicates a high antiquity. The Indian made and used, at the time of the discovery, certain implements and objects

* See his Presidential Address.

† The Bureau of American Ethnology estimates the number of the different stock languages at fifty-six among the American Indians; while the number of dialects is estimated at two hundred and over.

which have been continued in modern times by which he can easily be recognized and identified. Many of these are of the same type as those in Europe in neolithic times. But there are certain others, also ground, polished and drilled, some showing a high order of mechanism, art and industry, which had gone out of use and had become prehistoric among the Indians themselves. They have been found in mounds and show a pre-Columbian and ancient origin. The objects referred to are usually of the class termed ceremonial: banner-stones, bird-shaped, boat-shaped, spade-shaped, gorgets, tablets drilled or inscribed, sinkers, pendants or charms, tubes and certain specimens of stone pipes. The mounds themselves indicate a great antiquity, but their building and use seems also to have continued into later and possibly into modern times. The antiquity of the mounds has been a subject of great contention, but I refer to a foregoing quotation from Dr. Brinton,* and also the address of Professor Putnam delivered at this meeting (p. 73), where he says:

> Many of these shell mounds are of great antiquity * * * and cannot be regarded as the work of one people. * * * Thus it will be seen that the earth mounds, like the shell mounds, were made by many people and at various times. * * * So far as the older earthworks, such as Newark, Liberty, High-bank and Marietta group, the Turner, the Hopewell group, the Cahokia mound of St. Louis, the Serpent mound of Adams County, Forts Ancient and Hill and many others, have been investigated, they have proved to be of considerable antiquity. This is shown by the formation of a foot or more of vegetable growth upon their steep sides, by the primeval character of the forest growth upon them, and by the probability that many of these works, covering hundreds of acres, were planned and built upon the river terraces before the growth of the virgin forest.

If the above facts in regard to the origin of man on the Western Hemisphere be accepted as true (and it is difficult to see how they can be evaded), the conclusions announced of the minimum high antiquity of man in America seems incontrovertible; and I am glad to stand with Dr. Brinton and Professor Putnam in maintaining the same conclusion, however much we may differ as to the arguments by which it is reached.

We have assumed a migration from the Eastern Hemisphere as a means of accounting for the human occupation of the Western; how it comes that the human product in the Western Hemisphere should be different from its progenitors in the Eastern, is not involved in this discussion. The question belongs to the earlier one of the origin of races. If we question how the Red Race of America could have sprung from either one of the three or four races of the Eastern Hemisphere, we are involved in equal obscurity as to how the three races of the Eastern Hemisphere should have sprung from a single stock, assuming, as we have, the unity of the human species. The discussion of this question is not here pertinent; it belongs to another branch of the science of anthropology and is to be discussed otherwheres. If we accept the theory of the unity of the human species and that they all sprung from one stock, the conclusion may as well be accepted as to the formation of the Red Race in America, as to the Yellow in Asia, the White in Europe and the Black race in Africa. The problem of the peopling of America has been dealt with theoretically by M. de Quatrefages in his 'Historie Generale des Races Humaines,' wherein he assumes a combination of thirty individuals of the Yellow, twenty of the White, and ten of the Black race, who, placed on the common basis of an isolated colony anywhere in the Western Hemisphere would, by amalgamation and procreation, produce a race with the principal characteristics of the Red.

* Ante, p. 73.

Migrations of the Red Race in America.

Continuing our stand on the theory of the unity of the human species, we recognize that all the different races must have sprung from one stock, and this could have been done only by the most intimate physical connection. No theory of similarity of human thought and need will even assist in explaining this fact. The difficulties of migration all disappear before it; distances of time and place are as nothing. On the basis that the human species sprang from a single stock, the conclusion is not to be evaded that all the races, the Red among the rest, descended from the stock, generation after generation, from father to son and from mother to daughter; and this must have been true from the time of the first human pair down to those born in A. D., 1899. This proves the communication and relationship between all individuals of the human species and *a priori* that all human occupation of different countries, or passages from one country to another must have been accomplished by migration.

On this subject Sir John Lubbock (Prehistoric Times, p. 587) says:

> Assuming, of course, the unity of the human race, there can be no doubt that men originally crept over the earth's surface, little by little, year by year, just, for instance, as the weeds of Europe are now gradually, but surely creeping over the surface of Australia.

On this assumption, the questions of human migration, and with it the migration or importation of human industries, settle themselves. If the people migrated, they carried their industries with them. Their knowledge of implements, utensils and weapons, and how to make them, ought to be substantially the same in both countries, the country of immigration as in the country of emigration, and this we find to be true.

If the prehistoric man migrated from the Eastern Hemisphere to the Western, and commenced his occupation at the early period, the Paleolithic, as suggested by Dr. Brinton and as indicated by the possible existence here of paleolithic implements, he must have brought with him the knowledge of paleolithic industries, whatever those may have been. He may have come over in the Paleolithic period and had either a continued communication or a renewal of the migration. If his migration or the renewal thereof was not until the Neolithic period, then he brought with him the knowledge of that period. If we are to determine this by the similarity of industries, we would say that the last migration in prehistoric times was during the Neolithic period. Waiving for the moment any discussion as to whether the man of the Neolithic period was still in the savage stage of culture or had advanced to the barbaric, it is remarkable that the industries between the two countries should have been so nearly identical. Nearly every industry that would belong to a savage or barbaric people which might be regarded as necessary to their comfort if not their existence, is found in both Hemispheres, and in both substantially alike. In many industries, that is in the making and use of many implements, utensils, or weapons, they were exactly alike. There was in these cases, an absolute identity; the differences were not greater between the implements, etc., of the two Hemispheres than between those of any two countries in the same Hemisphere.

Similarity of Human Culture no Evidence of Similarity of Race, but is of Communication.

The similarity between man's culture in Europe during the Neolithic period, and that in America during the pre-Columbian period, extended to nearly every industrial object of importance relating to the lives of the two peoples. Nearly everything relating to tools or implements which one gen-

eration or one people could teach another, existed in both countries. I speak, not of the tastes, habits, customs, folk-lore, games, traditions, religions, beliefs, etc., which may or may not have been continued from one country to another, these may have perished or been lost in transmission; but I speak of the serious things of life, those which go to make epochs of culture, which determine civilization, questions involving sustenance of life, such as implements, utensils, weapons, the means by which life was maintained and made possible. I may speak, also, of the tools with which these implements were made and the method of their manufacture.* The lines on which this parallel are drawn are so broad as to include practically all savage or barbarian needs. The industries of chipping, battering, pecking, grinding, polishing, sawing and drilling were all applied to stone, bone, horn and wood, and were identical in Europe and America. The implements made from these materials and by these methods were similar, if not identical, in the two countries: stone hatchets, bow and arrows, spearheads, knives, scrapers, grinders, mortars and pestles, gouges, chisels, hammers. There is not more difference between these tools in the two Hemispheres than there is between them in any two countries in the same Hemisphere. A series of polished stone hatchets from Scioto Valley, Ohio, will, save only the difference in material, correspond favorably in form, size, mode of manufacture and possible use, with a like prehistoric series from almost any other country in the world. The same is true of all the implements mentioned in the list above. Pottery, which figures so extensively in the life of primitive man, was substantially the same in the two Hemispheres; spindle-whorls and thread, on which depended the art of weaving, and all the paraphernalia of nets and snares for catching game; these, like the others, were practically the same in both Hemispheres. There were differences in size, weight, material and ornamentation, but throughout the prehistoric period, they were substantially the same utensils. We find plenty of prehistoric weaving, more in Europe than in America, probably because the latter peoples wore clothing and made tents of skins; but the invention and use of the loom by which the product of the spindle-whorl could be utilized, was a machine of great intricacy and difficulty of manufacture. This intricacy and difficulty becomes magnified when we consider that the loom and the spindle-whorl form together but parts of the same machine and that to a large extent each depended on the other. When we find the machines and their products practically the same in both countries, it is an argument of great weight and carries with it a power of conviction.

One of the important industries in primitive life, whether savage or barbarian, was the treatment of skins of animals for tents or clothing. The first and most necessary implement for the treatment of skins is the scraper, and this is as true of the modern tannery as it was in the time of the shepherds on the plains of Chaldea. The scrapers of Europe and America are identical. The skins of prehistoric times in both countries, whether of tents or of clothing, have perished, and no traces of them are found; but the flint scrapers remain as a satisfactory and convincing evidence of the treatment of the material, and that in this, the early men of Europe and America were alike.

Lest some critic should pick a flaw in the foregoing statement of facts, I mention the teshoa, a kind of scraper peculiar to the foot-hills on the eastern slopes of the Rocky

* The architecture and possibly the sociology of the Aztecs in Mexico and the Incas in Peru should be excepted from this general statement and subjected to special investigation.

Mountains. It has been described by Professor Leidy, and specimens have been sent to the museum by Col. P. H. Ray. They were spauls from boulders, with a sharp edge, and were knocked off by the Indians during their buffalo hunts, used temporarily and left. This is believed to be the only exception to the universality of the stone scraper of the Neolithic age anywhere throughout the world.

Speaking of the similarities between the industries and implements of the two Hemispheres, I have used the term 'identical,' and the word is correct. There may be a difference in detail, arising from the separation of time and distance, but with all that, they were the same industries, the implements were the same, made of the same kind of material, by the same process and to serve the same purpose. If there is a difference between these industries and objects in the two Hemispheres, it is like the difference between the present fashion in dress in France and in the United States. But there will be a difference between the fashions of Paris and London or, to make it more patent, between the city-folk and the peasants, whether of France, Holland, Sweden, Scotland or Ireland. So are there differences between the fashions of the various cities or states in the United States; yet in all these countries, among all these peoples, however widely separated they may be, the difference is only of fashion; and all the costumes worn are at last the same articles of dress. This is a fair illustration of the differences between the stone hatchets or the arrowpoints and spearheads of prehistoric times in the countries named.

In Europe the stone hatchet was inserted in its handle, though there may have been variations of the mode of fastening. Arrived in America, we find the same stone hatchet, handled also by insertion. When the European neolithic man wanted an axe or a heavier chopping or splitting implement, he drilled a hole through the axe and inserted a handle, sledge-fashion. The prehistoric American did not adopt this style. He made a groove and tied a withe around his axe. This was a difference in detail between the style of implement of the two countries. It was not because the European man did not know to make a groove and put a withe around it, for his mining tools were made in that way; nor, on the other hand, was it because the American could not drill a hole in stone, for he drilled as much and as finely as did the European.

There were other differences of detail. The pottery of America may be larger and more finely made, but in both Hemispheres the processes were practically the same. There is as much difference to-day in pottery making establishments in adjoining shires or counties in either of the two countries, as there is between the countries themselves.

Ornaments of stone and shell may be different in the two countries, but they are at last but ornaments, and as such have their local fashion.

There may be other differences with other implements and industries, but they are of degree rather than of kind. I may fairly stand by the proposition that there will be found as great differences between the primitive or prehistoric industries, for example between those of the Atlantic and Pacific Coasts of America, between those of the United States and Mexico and Central America, as will be found between those of Europe and America; so, also, will there be as much difference between the industries and implements of the dolmen people and the lake dwellers, or between those in the Scandinavian and the Iberian Peninsulas.

Basketry may serve as an illustration. We have just received, at the U. S. National Museum, a fine collection of primitive basketry from California, representa-

tive of the Pacific Slope. It differs greatly from the prehistoric basketry of either Europe or the Atlantic Slope in that it is much finer and better made, but the stitches and plaiting are on the same general system and done in the same general style. While the difference is marked it is at last one of detail and may be explained. A theory by which the present difference may be explained is that the art became perfected in California, not alone since the migrations from Europe, but since the establishment of the Indians on the Pacific Coast, while it has died out on the Atlantic Coast.

Bronze found no lodgment in North America. A good explanation is that the migration from Europe by which America was peopled, took place prior to the advent of the bronze there. There might have been more than one migration to America; one during the Paleolithic and a later one during the Neolithic period; but it seems not to have been repeated after bronze became known in that country.

The principles which underlie this argument of similarity of industries as proving migration or communication or contact, do not depend alone upon the similarity of the objects, but also upon the difficulty of manufacture and performance, the intricacy of the operation required, the skill of the workmen; and to these may be added the closeness of resemblance, the similarity of detail, and the number of repetitions. A single specimen, or a few specimens having only an insignificant or uncertain similarity, might be of no avail in establishing the proposition of migration or communication of peoples between the countries; while, as the resemblances are increased, and an increase in the intricacies of manufacture, in the difficulties of performance, in the skill required to make or operate the tool or machine, would very materially increase the testimony in favor of migration, and add weight to the evidence.

The theory that the similarities of human thought account for the similarities of human culture in widely separated countries and among peoples without prior communication, savors of gross materialism, and is to be rejected as erroneous. That there are similarities of human thought is to be admitted, but if these control man in his progress and compel his passage in a materialistic or predestined path, they rob him of his free will and make him only a creature of circumstances. The best illustration I can suggest proving the error of this theory, is the action of human thought as manifested in human speech or writing. We may assume that human emotions, feelings, desires and wishes are much the same among all people. Each human being loves weeps, pities, hates, envies, etc., much the, same as does every other. If they were to describe their feelings, one might expect to find it done in much the same language. Yet we know, for a fact, that this is not so. If so done, it is charged as plagiarism. Of the thousands who have thus written, scarcely a 'baker's dozen' have ever been thus charged. The reason most apparent is that with all the similarity of human emotions, feelings, desires and wishes, the expressions thereof are so different when emanating from different authors that none lay themselves open to such a charge.

I am opposed to the theory advanced by certain anthropologists, that the similarity of human thought is a satisfactory explanation of the similarity of human culture in the case of widely separated peoples. That there is similarity of human thought between peoples, however widely separated, is conceded; but this theory is employed to account for the similarities of human culture otherwise than by migration, contact or communication. I prefer to account for similarity of culture (especially industrial) among widely separated peoples by migra-

tion, or by communication or contact. If we accept the doctrine of the unity of the human species, we are forced to admit contact between peoples of different countries as accounting for the differences in their cultures rather than to account for it by the similarity of their respective thoughts. The race could not have been perpetuated, the new peoples could not have been born, the different countries would never have been peopled, whether separated or not, except on the theory of migration and communication or contact. It is only by contact that subsequent generations could have appeared, and only by migration that they could have become separated. If the spread of culture by migration is denied, the spread of the race must also be denied. The two things, similarity of race and of culture, stand on the same foundation. This foundation is migration, communication, contact.

Monuments, Burial Mounds and Tumuli.

Nothing has yet been said as to the monuments or art of prehistoric man. The art is sufficiently explained in my work on 'Prehistoric Art'; published in the report of the U. S. National Museum for 1896, pp. 325–664, with 74 plates and 325 text figures, and I need not dwell further on it.

The monuments of prehistoric times are curious and strange. Whatever country we may consider, they excite our wonder and admiration. The ingenuity, invention, thought and general *savoir faire* of the prehistoric man as shown in his industries, and the taste and genius shown in his art, all pale before his ability as an architect and builder.

The principal monuments made by prehistoric man in most countries and times seems to have been funereal. The paleolithic man made no monuments, and it is doubtful if he habitually buried his dead. But the neolithic man expended his energies and powers in the erection of tombs and monuments intended to protect, and possibly to commemorate, his dead.

Dolmens were chambers of stone in which the dead bodies were placed. In Europe mounds were frequently, and in America were always erected over such burials, and these stand as testimonials of the affectionate regard with which the barbarian of prehistoric, whether in Europe or America, regarded his dead.

Although these monuments may not be the same in the details of their construction in both countries, they are all founded on the same principle of regard for the dead. This remark applies equally to Europe as to America. The burial tumuli and dolmens of Lozére and Morbihan in France do not contain a greater number of bodies than those of the Turner, or the Hopewell group in Ohio; while for size, extent and complicated design and perfection of execution, those we are to see during this session at Newark, Circleville and in the Scioto Valley will equal any throughout Europe.

The military monuments, fortresses, embankments, squares, circles and breastworks of the two countries tell the same story. They were built in both countries, sometimes of stone and again of earth, and show in every quarter an amount of engineering skill. The parallel lines at Marietta and Piketon, the circles and octagons on the State camp-ground at Newark, in the Scioto Valley, and at Portsmouth, Kentucky, have their counterparts in the extensive earthworks of protective ditch and embankment of Camp Peu-Richard at Saintes (Charente); while the fortresses and camps of stone or earth of forts Ancient or Hill, or opposite Bournemouth, are but the complements of Camp de la Malle (Alps Maritimes) or the great Gaulish fortress of Uxellodenum on the Dordogne.

Other monuments in Europe occupy a

relatively restricted area, the menhirs, isolated standing stones, cromlechs, alignments, standing stones erected in circles, and squares or parallels. No corresponding monuments have been found in America.

I must conclude. My time and your patience are about exhausted. I recognize my shortcomings and apologize for them; but who can accomplish in one address the history of the first appearance of man on earth and, describing the discoveries of the century, reduce them to the limitations and nomenclature of a new science? The difficulty is increased when we consider that the want of harmony on these subjects is as great among our own scientists as it is between them and their foreign brethren.

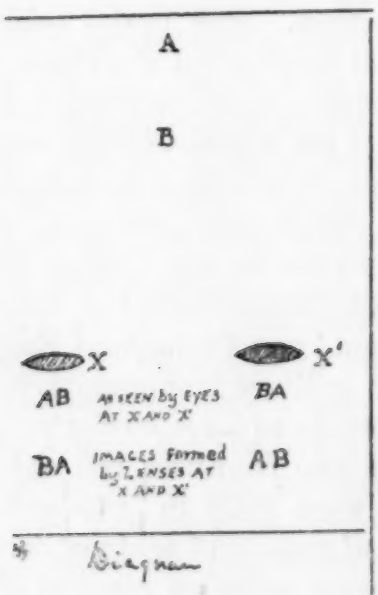
Thomas Wilson.

U. S. National Museum.

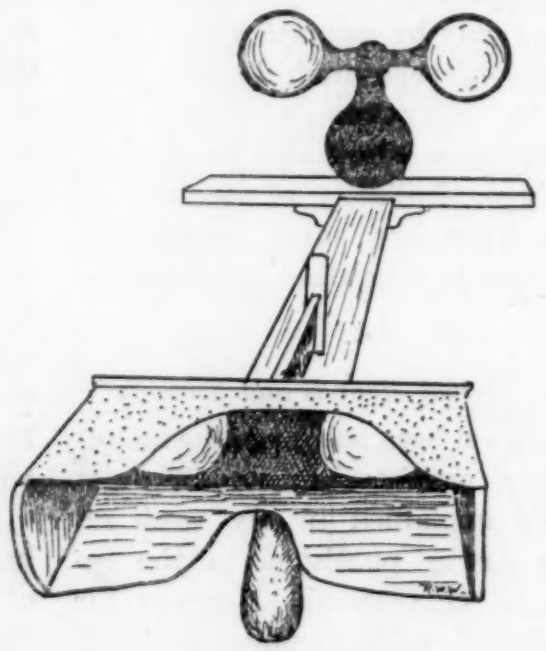
A NEW FORM OF PSEUDOSCOPE.

In the Wheatstone pseudoscope the left eye is made to see an object from the point of view of the right eye and *vice versa*, by means of a system of mirrors. I have recently devised a method of converting an ordinary stereoscope into a pseudoscope, which can be used to view near or distant objects, and which yields results far superior to the old form of instrument.

If two small lenses of equal focus (5 or 6 cms. is about right) are mounted side by side, they will form two inverted images in space lying in the same plane, of any object towards which they are directed. These images are not only inverted but have left and right interchanged, and when fused either by viewing them with the axes of the eyes parallel, or by means of a stereoscope will give rise to pseudoscopic vision, as will be readily understood by reference to the diagram.



Diagram



A new Pseudoscope.

Figure.

Let A and B be two points in space, B being in front of A. An eye at X will see B to the right of A, and an eye at X' will see B to the left of A, and the fusion of these two images produces stereoscopic vision, B appearing nearer than A. Suppose now that X and X' represent the two

lenses. The images which they will form in space will be reversed, that is the lens X will give an image* in which B will be to the left of A, or just the opposite of the appearance presented when the eye is at X. It is apparent that the images BA and AB formed by the lenses are identical with what would be seen by eyes at X and X', provided A were in front of B, consequently the fusion of these two images makes A appear nearer than B.

It is possible for one who has trained the eyes to view stereoscopic photographs without the aid of the stereoscope, to bring the two images together in the same manner, but most persons will require the assistance of the prisms. My instrument consists simply of a double magnifying glass (consisting of two lenses mounted in rubber frames) mounted on the picture holder of an ordinary stereoscope, as shown in the figure.

A neater device would be two small lenses cut square and mounted in a frame arranged to slide along the bar of the stereoscope, or better still the instrument could be given the opera-glass form.

The best objects to view with the instrument are small decorated bowls either right side up or bottom up, and such simple objects. They appear to the best advantage when viewed from above.

The image appears reduced in size but exceedingly brilliant and sharp and the pseudoscopic effect is sometimes perfectly startling.

If the experiment is tried in the manner which I have described with a double magnifying glass, it is important to see that the two lenses have the same focal length, which is often not the case.

R. W. WOOD.

MADISON, Wis.

*I have drawn the images formed by the lens erect for the sake of simplicity. They are, of course, inverted in reality.

THE SUBDIVISION OF GENERA.

IN view of the almost universal acceptance of the doctrine of evolution by naturalists, most of the old discussions regarding the 'generic value of characters' read much like those about the nature of phlogiston. If we must admit that even species are largely conventions, holding good only so long as our observation of them is limited in respect to time, areas and conditions, the larger subdivisions—genera, orders, etc.—must necessarily and *a fortiori* be regarded in the same light, as groups comprising forms agreeing in a large number of important and striking characters, and which it is, therefore, convenient to regard from a common standpoint for the purposes of study; as forms probably derived from a common ancestor at a relatively not very remote time. If then admittedly genera are not established by nature but are man-made, it would seem desirable to adopt with reference to them the policy most conducive to a ready and comprehensive view of their relations to other groups of forms, and to facility of study. The latter consideration should weigh heavily, in view of the steadily increasing interest and instruction in natural science. It is certain that the study of the latter is greatly hindered by the multiplication of names, both generic and specific, and by the unnecessary substitution of terms of Greek and Latin derivation for well-understood English words of definite meaning.

On the other hand, the detailed study of any group by specialists necessarily results in the discovery of new common characters within certain closely-related groups of forms, by which they may be conveniently subdivided for comparative study. Of course, there can be no question of the importance of such study of the minute characters, which leads us more and more closely to the immediate effects of environment. The only question is how best to

make the results of such studies available to the general student, without at the same time compelling him to become a specialist himself (at least for the time being), at the cost of time and mental strain that can be more profitably otherwise employed. Excessive, and especially premature specialization, *pre*ceding instead of *suc*ceeding the establishment of a broad basis of general knowledge, is recognized as one of the most serious evils of our present system of scientific training and investigation. The specialist is becoming less and less capable of fruitfully correlating his results with the general facts and principles of the cognate branches of science, and the overweening self-esteem born of narrow training and ignorance of wider fields, is too often apparent both in writings and personal intercourse. At the same time, the coining of unnecessary new terms and names, more especially indulged in by this class of investigators, renders even their good work difficultly available to students outside of their specialties. Among the most aggravated and aggravating difficulties so imposed is the introduction of new generic names upon the basis of discrimina alleged to be cogently 'generic'; a tendency fostered by the ambition to have one's name forever associated with such new names.

Now if, as evolutionists must hold, genera, and orders as well, are essentially group arrangements made by man for the purpose of subsuming related forms under a general point of view for more ready and fruitful study, it would seem that the more comprehensive such points of view can be made, the better the main purpose will be subserved. So far from being closely *limited*, the definition of the genus should be as *wide* as possible; so that for the purposes of the general student, its members would be called by the most comprehensive name compatible with the objects of general study.* The specialist, on the other hand, may make use of the wider designation so far only as it may be useful for his discussion, while employing for the minor subdivisions required by his new points of view, such 'subgeneric' or 'sectional' designations as have heretofore stood for ill-defined genera.

It seems to the writer that the generalized point of view could thus be kept within convenient reach of the general student, while the subgeneric designations would afford the specialist ample facilities for discussion with his fellow-workers. Anyone desiring to specialize in a particular line would readily familiarize himself with the specialist's subgeneric or sectional terms. It would seem that in this way, the interests of both classes of students, as well as of science at large, would be effectually safeguarded and fostered, and the participation of a wider constituency in science study essentially facilitated.

E. W. Hilgard.

* A striking example of the opposite principle appears in Bulletin 18 of the Division of Agrostology, 'Synopsis of the genus *Sitanion*.' In the introduction, Scribner, in giving the characters upon which the genus is based as distinct from *Elymus*, remarks that they '*justify* the separation of these species as a distinct genus,' although "to be sure there are species so closely connecting *Elymus* with *Sitanion* that it is difficult to say to which genus they ought to be referred." These intermediate forms "indicate their close relationship, but this fact does not afford sufficient reason for *uniting* them. * * *"

Here it is evident that the view held is that genera should be as *closely limited* as possible; regardless of the fact that the obvious close resemblance of these plants will put every student, not a specialist, to the trouble of eliminating all the species of the well-known genus *Elymus* before considering the unfamiliar *Sitanion*; which as a subgenus of the former would have just the standing its slight structural differences seem to justify.

THE CARD INDEX OF EXPERIMENT STATION PUBLICATIONS.

In view of the recent discussions regarding card indexes of scientific literature many of the readers of Science may be in-

terested to know something about such an index which is regularly issued by the Office of Experiment Stations of the United States Department of Agriculture. The general plan of the index may be briefly outlined as follows :

The subjects with which agricultural science deals have been grouped under thirteen general topics. These topics have been divided and subdivided only so far as seemed necessary to facilitate references to the individual entries of the index. As the work of the stations reaches out in many directions into the domain of pure as distinguished from applied science, a section of the index has been set apart for entries relating to the general principles of the various sciences which lie at the foundation of experimental investigations in agriculture. This affords a wide opportunity for the extension of the index by individual students for their own special purposes.

The index is printed on cards of a standard library size. The divisions and subdivisions are arranged on a decimal system and are plainly indicated by the use of division cards of different colors.

Each index card contains the title of an article, the name of its author, a reference to the publication in which it appeared and to the Experiment Station Record, and a condensed statement of its contents. At the upper right-hand corner of the card is a number indicating under what head the card should be placed in the index. The order in which the cards are printed is indicated in the lower left-hand corner.

A key to the index, containing the system of classification, is sent with the first installment of cards.

While planned so that any scientific and other literature relating to agriculture might be included, the index has thus far been confined to the publications of the agricultural experiment stations in this country.

One copy of the index is sent without charge to each of the agricultural colleges and experiment stations and the State boards of agriculture. Besides this free distribution, the Office is prepared, under the authority of the law, to furnish a limited number of sets of the index at a price only sufficient to cover additional cost of printing. This is estimated at $2 per thousand cards. For the division cards an additional charge of $1.25 is made.

The Office has now issued 18,000 index cards and a set of division cards. Three hundred sets of this index are printed.

Experience has shown many difficulties in making such an index thoroughly satisfactory. Where publications are issued as irregularly as those of the experiment stations necessarily are, the systematic indexing of their contents inevitably prevents the bringing of the index closely up to date. To keep the number of cards within reasonable limits and satisfy the needs and demands of specialists in different subjects is practically out of the question, especially in such subjects as entomology, where many different topics are often treated in a single article and the important article consists of a series of short notes.

The chief value of such an index seems to lie in the fact that it enables the user to get together rapidly a considerable amount of information on many of the topics included in it. Thus the student, teacher or lecturer is helped in his work in various ways. But when it is desired to make an exhaustive study of any subject the card index is likely to be of comparatively little use unless it could be made very extensive, in which case few libraries would care to give it room.

For the thorough examination of the literature of any scientific subject, I believe that no work of reference can compare with a well-made abstract journal having a detailed subject and author index. Such an index the Office of Experiment Stations at-

tempts to make for the Experiment Station Record. The ninth volume of the Record contains 1,100 pages of text, of which 770 pages are taken for abstracts of publications originally occupying 56,569 pages. In addition to this, the volume contains 2,471 titles of articles, with brief abstracts in some cases. The index of names for this volume fills 15 pages printed in nonpareil type in three columns; the index of subjects fill 80 pages printed in the same type in two columns.

Now that ten volumes of the Record have been completed, the question of making a general index to cover them has been raised. If such an index can be provided for at intervals of ten years it is believed that this and the annual indexes with a set of the Record will constitute an instrument for ready reference to the literature of agricultural science much more convenient and effective for the uses of the specialist than any card index can be.

A. C. True.

Washington, D. C., October 23, 1899.

SCIENTIFIC BOOKS.

West Virginia Geological Survey. Volume I. By I. C. White, State Geologist, Morgantown, W. Va. 1899. 8vo. 392 pp. Map.

Dr. White was commissioned as State Geologist in 1897 and began work in the autumn of that year. This first volume gives only a portion of the material accumulated prior to the close of 1898, as the appropriation for printing was very small. Political complications during the session of 1899 hindered legislation and the survey work will remain suspended until after the next session of the Legislature.

At the time this survey was undertaken, the all-absorbing matter of economic interest was that of oil and gas, with which Part IV. of the report, occupying 270 pages, deals. The historical sketch of discovery, methods and utilization of oil and gas in the State is followed by a discussion of the geology of those products, treating of method of occurrence; quantity to the acre; aids in location; anticlinal theory; relation of oil and gas to structure; and other topics full of interest, viewed from the standpoint either of pure science or economics. The anticlinal or structural theory of the occurrence of oil and gas, presented by Dr. White many years ago, is elaborated here in the light of developments made in the Ohio and West Virginia fields. Though leading to slight modification of statements made when the theory was rather suggested than asserted, these severe experimental tests have rendered necessary no material changes, but on the contrary have shown that the theory was but the expression of a law. One cannot give a synopsis of the discussion for that is itself a model of condensation. It possesses much interest not only for the student of economic geology, but also for those geologists who find little that is attractive in matters relating to economic interests.

The general section through which wells have been drilled is described. It extends from the Permo-Carboniferous to the Corniferous limestone, a total of 7,200 feet, a thickness contrasting notably with that in south central Pennsylvania, where the upper Devonian alone (the Chemung and the Catskill of Vanuxem) is as great. The records of 104 wells drilled in different parts of the State are discussed in detail, compared with each other and with localities where the rocks are exposed. These wells are from 1,000 to more than 4,000 feet deep. The labor involved in working up the bald records into intelligible sections, of identifying the several coal beds and the subordinate sands, can hardly be conceived by those who have not done such work; the more so, since necessarily the published records form but a small part of those studied in order make the comparisons conclusive. The writer in the course of a study, still in progress, tabulated all these records given by Dr. White to compare them with results obtained by other observers in West Virginia, Ohio and Pennsylvania. Out of all the many points at which the several sets of observations came together, only two were found where it seemed impossible to accept Dr. White's conclusions—and in one of these Dr. White proved to be right.

This volume is a contribution so important that one cannot fail to regret the neglect of the

Legislature which has prevented publication of the volume on coal. That interest, owing to the sudden expansion of iron manufacture, is now paramount, and the state is losing enormously by this failure to publish the material accumulated by Dr. White in extended reconnaissances during the last ten years. To those engaged in investigating the serious problems presented by the Carboniferous, the inaccessibility of this material is a misfortune.

The map shows the oil fields and productive areas of the several coal series. The limits of the Pittsburg, as determined by borings, differ from the Rogers lines as much for West Virginia as for Ohio. The geographical conditions during the formation of that bed were evidently very unlike those suggested by the older geologists.

The abundance of typographical errors is evidence that the author had no opportunity to correct the proofs, and reminds the writer of his own experience with the West Virginia State Printer almost thirty years ago, when Mr. F. B. Meek and he were made chargeable with statements which afforded some annoyance to them and much amusement to their acquaintances.

JOHN J. STEVENSON.

Introduction à la géométrie différentielle suivant la méthode de H. GRASSMAN. Par C. Burali-Forti, professeur à l'Académie militaire de Turin. Paris, Gauthier-Villars. 1897. 8vo. Pp. xi + 165.

This volume contains a brief exposition of the geometrical calculus and some of its applications to elementary differential geometry.

The analytical geometry of Descartes (1637), operates on numbers which have an indirect relation with the geometrical elements which they represent. Leibnitz* in 1679 recognized the advantages of a geometrical calculus operating directly on geometrical elements, but the operation suggested by Leibnitz does not possess the ordinary properties of algebraic operations. The idea, however, was fruitful, and in 1797 Caspar Wessel† gave an analytical representation of direction which contains Argand's (1806) geometrical interpretation of complex numbers and several of the operations introduced by Hamilton (1843–1854) in his method of quaternions. Later the barycentric calculus (1827–1842) of Möbius and the method of equipollences (1832–1854) of Bellavitis brought forward two independent methods of geometric calculus which their authors applied to various questions of geometry and mechanics. In 1843 Hamilton published his first essay on quaternions; the complete development of this theory in 1854 gives a complete geometrical calculus which finds at present its most extensive applications in mathematical physics. The works of Hamilton were preceded by the Ausdehnungslehre (1844), of H. Grassmann which, in the power and simplicity of its operations, surpasses all other known forms of geometrical calculus. The method of exposition adopted by Grassmann is exceedingly abstract and this fact has stood stubbornly in the way of the general adoption of the Ausdehnungslehre to such an extent that we use to-day the barycentric calculus, the theory of equipollences, quaternions, or the Cartesian geometry, for the resolution of geometric questions which are capable of much more simple resolution by the methods of Grassmann. These classic objections to Grassmann's exposition have been met recently by Peano* who has given concrete geometric interpretations to the forms and operations of the Ausdehnungslehre. There is a splendid account of the importance of this discipline in geometry, mechanics and physics to be found in the historical memoir of Schlegel.†

M. Burali Forti gives the elements of Grassmann's calculus as reconstructed by Peano. The latter took the idea of a tetrahedron as his starting point and defined the product of two and three points; he then defined the products of these elements by numbers and finally gave definitions of the sums of these products. The theory of forms of the first order gives the barycentric calculus and that of vectors; the geometric forms of the second order represent straight lines, orientations, and systems of forces

* Leibnitz, *Math. Schriften*, II., V., Berlin, 1849.

† Caspar Wessel, Om Directionens analytiske Betegning, March 10, 1797; published by the Denmark Academy of Sciences, Copenhagen, 1897.

* Peano, Calcolo geometrico, Turin, 1888.

† Schlegel, Die Grassmann'sche Ausdehnungslehre, *Zeitschrift für Math. und Physik*, 1896.

applied to rigid bodies; the forms of the third order represent planes and the plane at infinity. Among the operations, the progressive and regressive products give the geometric operations of projecting and cutting; the inner product gives the orthogonal projections and the elements which we designate in mechanics by the terms moment, work, *et cetera*.

In ordinary differential geometry simple properties most frequently yield themselves only after very complicated calculations. This complication is due in general to the use of coördinates; with these coördinates algebraic transformations are made on numbers in order to obtain certain formulæ, namely, invariants, which are susceptible of geometric interpretations. On the other hand the geometrical calculus makes no use whatever of coördinates; it operates directly on the geometric elements; each formula which it produces is an invariant, capable of a simple geometric interpretation and leading directly to the graphic representation of the elements considered. Burali-Forti's work, though by no means a pioneer in the application of Grassmann's theories to differential geometry (note for example the memoirs of the younger Grassmann in the theory of curves and surfaces), shows the elegant power and simplicity of the geometrical calculus in elementary differential geometry and points the student to a vast field of transformations and researches in higher geometry.

The work is designed after the following plan which exhibits the skeleton of its contents:

I. The geometric forms.—1° Definitions and rules of calculus:—tetrahedron, geometric forms, equality of forms, points, segments, triangles, sum and product by a number, progressive product; 2° Vectors and their products:—vectors, bivectors, trivectors, rotation, operation index; 3° Reduction of forms:—forms of the first order, forms of the second order, forms of the third order, projective elements, identity between forms of the first order; 4° Regressive products:—forms of the second and third orders, forms of the third order, general properties of products, duality, regressive products in a projective plane; 5° Coördinates.

II. Variable forms.—1° Derivatives:—definitions, limit of a form, limit of a projective element, derivatives, mean forms, Taylor's formula, continuous forms; 2° Lines and envelopes:—lines and envelopes of straight lines on a projective plane, space curves and envelopes of planes; 3° Ruled surfaces:—ruled surfaces in general, skew ruled surfaces, developable surfaces; 4° Frenet's formulæ:—arcs, curvature and radius of curvature, torsion and radius of torsion, formulæ of Frenet, spherical indicatrix and angle of contingence.

III. Application.—1° Helix; 2° Surfaces ruled relative to a curve—polar surface, rectifying surface, surface of principal normals, surface of binormals, skew ruled surfaces whose line of striction is given, developable ruled surface described by a straight line whose position is fixed with regard to the tetrahedron PTNB; 3° Orthogonal trajectories:—orthogonal trajectories of the generatrices of a ruled surface, evolutes, involutes, orthogonal trajectories of planes of an envelope; 4° Curves of Bertrand.

Notes.—1° Forms which are functions of two or more variables; 2° Tangent plane; 3° Differential parameter of first order; 4° Curvilinear coördinates.

E. O. Lovett.

Princeton, New Jersey.

Chemical Experiments. By John F. Woodhull, Professor of Physical Science, Teachers College, Columbia University, and M. B. Van Arsdale, Instructor in Physical Science in Horace Mann School and Assistant in Teachers College. New York, Henry Holt & Co. 1899. Pp. 136. Price, 50 cents.

This book gives a series of very elementary experiments dealing chiefly with the elements oxygen, hydrogen, chlorine, sulphur, nitrogen and carbon. The apparatus recommended for the experiments is simple, and in several cases, quite ingenious. For pupils of a certain grade the book will doubtless prove useful, but the introduction of a few more quantitative experiments designed to illustrate fundamental principles seems desirable.

A Laboratory Outline of General Chemistry. By Alexander Smith. Chicago, Kent Chemical Laboratory of the University of Chicago. 1899. Pp. xii+90.

The work before us represents a very dis-

tinct advance in the teaching of General Chemistry. Dr. Smith appears to recognize more clearly than most teachers have done that chemical experiments for beginners should not be selected merely or chiefly to give a knowledge of the striking superficial properties of a few substances, but that they should be so devised that the student may acquire a direct experimental knowledge of those facts on which the real science of chemistry rests. For this reason the book contains an unusual number of carefully selected quantitative experiments. The book is notable also because of its introduction of experiments to illustrate ionization and the phenomena on which the modern theory of solutions is based. The directions are of such a nature, too, as are suited to develop independent thought and self-reliance. The student who thoroughly masters the course laid down will have made a good beginning toward an understanding of chemistry and of how chemists work. W. A. NOYES.

GENERAL.

La Théorie de Maxwell et les Oscillations Hertziennes, by H. Poincaré (Paris, George, Carré et C. Naud, 1899), is a popular exposition of the mathematical treatise on the subject by the same author, which was reviewed in SCIENCE for January, 1895. It is one of the series of popular treatises on scientific subjects published under the general name 'Scientia.' It is very attractive both in form and in substance and will furnish much interesting reading to those who have neither time nor inclination to study the mathematical treatise. M. I. P.

THE excellent 'Manual of Bacteriology' of Muir and Ritchie (The Macmillan Company, 1899), already reviewed in these columns, has in the second edition been revised, brought up to date and somewhat enlarged. It is, as was the first edition, a bacteriology for medical folk. About one-quarter of its pages are concerned with general technique; the remainder with excellent, short and clear, but fairly comprehensive descriptions of pathogenic microorganisms. The exposition of that difficult and dangerous theme, immunity, is admirable. The bibliographic suggestions are good, the historical glimpses illuminating. Altogether, the book is of such evenly sustained excellence throughout, that among a small host of competitors of similar scope in various languages, it easily holds the leading place. T. M. P.

THE authorities of the Royal College of Surgeons in England have made arrangements for the compilation of a descriptive catalogue of the vertebrate brains in the Museum. Dr. G. Elliott Smith, of St. John's College, Cambridge, will undertake the work.

BOOKS RECEIVED.

The Elements of Alternating Currents. W. S. FRANKLIN and R. B. WILLIAMSON. New York and London, The Macmillan Company. 1899. Pp. 212.

Pulmonary Tuberculosis; Its Modern Prophylaxis and the Treatment in Special Institutions and at Home. S. A. KNOPF. Philadelphia, P. Blakiston's Son & Co. 1899. Pp. 343.

The Story of the Fishes. JAMES NEWTON BASKETT. New York, D. Appleton & Co. 1899. Pp. xxii + 297.

About the Weather. MARK W. HARRINGTON. New York, D. Appleton & Co. 1899. Pp. xx + 246.

Determination of Radicles in Carbon Compounds. H. MEYER. Authorized translation by J. BISHOP TINGLE. New York, John Wiley & Sons; London, Chapman and Hall, Ltd. 1899. Pp. iv + 133. $1.00.

SCIENTIFIC JOURNALS AND ARTICLES.

IN *The American Naturalist* for October the leading article is an interesting paper of 'Notes on European Museums,' by O. C. Farrington, giving many interesting details of methods of installation. An important paper by O. P. Hay is 'On some Changes in the Names, Generic and Specific, of certain Fossil Fishes,' noting a number of names which must be considered as synonyms and replaced by others which are suggested. The 'Utility of Phosphorescence in Deep-Sea Animals' is discussed by C. C. Nutting, and C. P. Sigerfoos describes 'A New Hydroid from Long Island Sound' under the name of *Stylactis hooperi*. The habits of 'A Balloon-Making Fly,' an *Empis*, is described by J. M. Aldrich and L. A. Turley, while the question 'Have we more than One Species of *Blissus* in North America' is answered in the negative by F. M. Webster. The fourth part of 'Synopsis of North-American Invertebrates'

is by J. S. Kingsley and is devoted to the 'Astacoid and Thalassinoid Crustacea.' The balance of the number is devoted to Reviews and News. The very useful list of appointments to various scientific positions here and abroad is unusually full.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON 310TH MEETING, SATURDAY, OCTOBER 21ST.

F. A. Lucas made some remarks on the flightless Harris' Cormorant, stating that the keel of the sternum was lacking save the anterior point to which the furcula was attached, that the pelvic girdle was very robust, though not quite equal in this respect to the larger Pallas' cormorant. The nearest relative was *Phalacrocorax penicillatus*.

O. P. Hay presented 'A Census of North American Fossil Vertebrates,' giving the number of genera and species in each order. Special attention was called to the great number of selachians represented in the Sub-Carboniferous and their apparent scarcity in the succeeding formations.

V. K. Chesnut presented some 'Notes on a Preliminary Catalogue of Plants Poisonous to Stock,' saying that some plants were not in themselves poisonous but acted by clogging the intestines, perforating and inflaming the tissues of the eyes, nose or intestinal tract, or by the evolution of gases which distended the stomach and intestines to such an extent that the lungs and heart could not properly perform their work. Corn smut was deleterious from the expansion of the dry powdery spores, while some molds whose spores will germinate and grow in the body apparently produce a poisonous compound concomitantly with their growth. It was noted that some plants vary greatly in virulence at different seasons, and that others which were useful in small quantities were injurious when fed continuously.

H. J. Webber spoke on 'Polyembryony in Orange Hybrids,' calling attention to the curious results obtained in hybridizing the Trifoliate orange (*Citrus trifoliata*) with the Sweet orange (*Citrus aurantium*). In a number of instances two totally different seedlings were produced from the same hybrid seed. Of the numerous embryos produced in a single orange seed, one apparently develops normally from the fecundated egg cell and the other from certain cells of the nucellus near the upper part of the embryo sac, which become specialized, divide rapidly, and pushing out into the embryo sac form embryos. Usually several of these adventive embryos are developed in each seed. In hybridization the embryo developed from the egg cell is naturally the only one which shows any influence of the male parent. The adventive embryos which spring from the nucellar tissue of the mother parent could not be expected to show any effect of the cross. In crosses of the Sweet orange with pollen of the Trifoliate orange several seeds have developed more than one seedling, of which one has trifoliolate leaves similar to the pollen parent and the other, or others, unifoliolate leaves like the sweet orange mother parent. In such cases the speaker thought there can be no doubt that the trifoliolate seedling develops from the egg cell and is the only one affected by the hybridization, while the unifoliolate seedlings develop from adventive embryos and are not affected by the cross.

Albert F. Woods gave some 'Additional Notes on Spot Disease of Carnations,' stating that as the result of long experimentation he was able to positively confirm his former statements that the disease was not produced by bacteria, but was caused by the punctures of Aphids and Thrips. The curious device by which the slender bill of the aphis was enabled to be inserted between the plant cells was also described.

O. F. Cook,
Secretary.

SECTION OF ANTHROPOLOGY AND PSYCHOLOGY OF THE NEW YORK ACADEMY OF SCIENCES.

The regular meeting of the Section was held on October 23d. Dr. E. L. Thorndike reported some experiments on mental fatigue. The general plan of this investigation has already been described in Science of May 19th. The experiments reported confirm the earlier conclusion that there is no decrease in amount, speed or accuracy of work in the evenings of days of hard mental work over mornings or in

periods immediately following prolonged mental work over periods preceding it.

Dr. Livingston Farrand read a paper on 'Basketry Designs of the Salish Indians.' The paper was a contribution to the solution of the problem of the evolution of decorative art and particularly of the question of development of geometric patterns from realistic portrayals of natural objects. Attention was confined to the basketry designs of the Salish Indians of British Columbia and western Washington, which exhibit certain peculiarities marking them off rather sharply from the designs used by neighboring stocks. It was shown that while the adjacent tribes in the Northwest make use almost exclusively of animal designs, and their conventionalism is of a unique nature and not geometric, the tendency of the Salish decorations, on the other hand, is entirely in the direction of extreme geometric conventionalization and the use of animal motives is not predominant. The questions of variants and of convergent evolution in designs were discussed, and the points made were illustrated by the exhibition of a large number of designs taken from the baskets collected by the Jesup North Pacific Expedition from the region under discussion.

C. H. Judd read a paper on 'Movement and Consciousness.' Reference was made to the recent psychological discussions which have emphasized the importance of movement and motor nervous processes as conditions of consciousness. It was pointed out that just as psychology must look for the conditions of sensation elements in non-psychical processes, so a careful analysis of the facts of perception force us to look for the represented factors and for the synthetic activities in non-psychical conditions. In support of this position examples were cited in which the representative factors were not capable of conscious revival even with concentrated attention, and it was shown that synthetic activities become progressively less conscious the more complete and immediate the process of perception becomes. Finally, the attempt was made to discover in the facts of movement and in the nervous processes which follow the reception of sensory stimulations, the conditions of perceptual synthesis and the conditions which make possible present effects of past experience without complete or even partial revival of any sensory factors, either as revived sensations or as repeated sensory stimulations in the nervous system.

CHARLES H. JUDD,
Secretary.

DISCUSSION AND CORRESPONDENCE.

RECENT WORK ON COCCIDÆ.

THE writer was away from his office and without access to current literature for most of the summer just passed, and only recently has seen in SCIENCE for July 21st (pp. 86–88), the reply of Professor Cockerell to the article entitled 'Sources of Error in Recent Work on *Coccidæ*' (SCIENCE, June 16, 1899, pp. 835–837). The article last cited was written with no other intent than to point out, with the hope of benefiting the future literature on the subject, certain sources of error which were being rather emphasized by some of the more recent work on scale insects. To avoid personal features, the enumeration of examples was reduced to a minimum and the chief offenders were not pointedly indicated. That some check of this sort was needed is evident enough to any one familiar with the literature, and is further shown by the writer's having received, since the publication of the article cited, letters thanking him for his action from several of the leading entomologists of this country and oral thanks from a good many others, not to mention such editorial approval as that in the *American Naturalist* for September, 1899.

Professor Cockerell's reply serves two very useful purposes. First, it does what the writer, through a perhaps ill-advised sense of courtesy, failed to do, namely, indicates the real and chief offender, who now comes to the front and courageously announces, 'I am the man!' In the second place, it enables him to point out definitely the character of work which had previously been referred to in very general terms out of consideration for the persons concerned whose work in the main it was not wished to disparage.

The opening remarks of Professor Cockerell, relative to his eight years experience in *Coccidæ*, are rather regrettable in view of some of the

results they have yielded; in fact, this whole paragraph reminds one more of the efforts of an attorney with a bad case to indulge in disparagement of the opponent rather than the introduction of evidence. In discussing at length, as Professor Cockerell does, the difficulty in determining what are good specific characters, very safe ground for dilation is found, but unfortunately this discussion has little bearing on the criticisms in the original article which applied for the most part to the use of trivial characters, or such as have no relation whatever to the insect itself, but rather to its coverings and general surroundings.

Coming now to the example of the kind of work mentioned, and the complaint is made that the writer has generalized on very insufficient grounds, the synonyms for which Professor Cockerell is responsible of a single species will be considered, and these furnish ample material to illustrate the faults alluded to. The species taken to serve this purpose is *Aspidiotus lataniæ* Sign., hitherto known in this country as *Aspidiotus cydoniæ* Comst.,* and variously by Professor Cockerell as the species last mentioned and also *convexus* Comst., *punicæ* Ckll., *greenii* Ckll., *lateralis* Ckll., and *crawii* Ckll. In other words, the synonyms of this species, as given by the writer in a recent number of the *Canadian Entomologist*, indicates that within the last three or four years Professor Cockerell has redescribed it not less than four times, besides indicating a fifth form by reference of material to '*convexus* Ckll. not Comst.'

If one examines the characters on which Professor Cockerell separated these supposed new species, now shown to be synonyms of *lataniæ*, their trivial, if not farcical, nature will be apparent.

Before considering the status of these synonyms, it may be said in explanation that when Professor Cockerell was last in Washington he was invited by the writer to examine the type material representing them in the Department collection and to point out the characters upon which the species are based, the original descriptions having been very inadequate. He made such study and was unable to give structural characters of the insects themselves, but submitted a synoptical table based chiefly on the scale covering, as indicating his reasons for believing the species to be good. This table follows:

PROFESSOR COCKERELL'S TABLE.

1. Exuviæ dark brown or black..... 2
   Exuviæ pale orange or brownish..... 3
2. Lower Sonoran and tropical.....*cydoniæ* Comst.
   Upper Sonoran, on Salicaceæ and Melia
   convexus Ckll. not Comst.*
3. Exuviæ central or almost in the mature ♀ scale. 4
   Exuviæ lateral or sub-lateral in the mature ♀ scale (circumgenital glands few, groups of 2–5 only)..... 5
4. Scale snow white; on *Punica*.....*punicæ* Ckll.
   Scale greenish; mostly on Palms.....*greenii* Ckll.
5. Scale grayish brown; inner notch of median lobes absent, spines longer.....*lateralis* Ckll.
   Scale rather larger, reddish gray; inner notch of median lobes distinct; spines shorter; processes of first interlobular interval short united
   crawii Ckll.

To appreciate this table it should be explained that the species concerned *lataniæ*, secretes in the case of the female a convex circular scale, and moults twice, the cast skins or exuviæ, and especially the second and larger one, ultimately becoming brownish in color and forming part of the central portion of the scale covering. The scale secretion proper is of white wax, but is as a rule discolored by a thin shale of bark carried up over it and by the dirt or mould which accumulates on the bark or on the scale itself. The exuviæ attach to the inner central portion of the scale and show through it as a brownish

* *Aspidiotus lataniæ* was described so briefly by Signoret that without an examination of the types it was altogether impossible to recognize the species in new material, and the failure to do so hitherto has every excuse. Fortunately, Mr. E. E. Green has recently been able to examine Signoret's types and has drawn up a careful and full description of the species, accompanied by an excellent figure of the last segment of the adult female insect. He points out the close resemblance of Signoret's species to Comstock's *cydoniæ*, and a comparison which I have made of Mr. Green's description and figure with type material of *cydoniæ* shows conclusively the identity of Comstock's species with Signoret's.

* Some of the material thus referred actually represents an apparently undescribed species, but not that on the food plants mentioned.

spot. The approximately central position of the exuviæ is a generic character and applies to scores of species, but is often modified and quite naturally by the crowding of the scales or by irregularities of the surface on which the insect rests. The shade of brown of the exuviæ varies with the age of the scale, from pale orange at the start to different shades of brown, darkening more or less with time and exposure, and as influenced by conditions of moisture or dryness or different food plants, etc.

The question of locality is of little value, the species itself having a wide distribution and belonging to a group having an extensive range in point of latitude. The few structural characters noted, where they are not evidently based on the accidental effects of preparation and mounting, are included in the normal variation of typical specimens of Comstock's *cydoniæ*.

There remains, therefore, to be considered merely the extremely variable colorational features of the scale covering. Referring to the table, it will be seen that the supposed species are divided into two groups on the shade of color taken by the drying bit of cast skin or exuvia. The species with 'dark' exuviæ are separated on the ground of latitude, namely, those from north of a certain arbitrary line are *convexus*, and those from south of the same line are *cydoniæ*.

The group with lighter colored exuviæ (and be it remembered that with practically every lot of material the exuviæ of different specimens range widely in color) is again separated into two sections by the alleged central or non-central position of the exuviæ. An examination of the type material indicates that the only possible basis for this is that in the scale or scales which happened to come under Professor Cockerell's eye, the exuviæ were pushed slightly to one side by conditions already noted. In this group, *punicæ* is differentiated by its possessing a snow white scale (which simply means that the scales examined happened to be free from extraneous matter), *greenii* is characterized by its having central exuviæ (sic !) and by a greenish coloration (which latter proves on examination of the material submitted by Professor Cockerell to be caused by a greenish mold or fungus which covers exteriorly a few of the scales. It must be confessed, however, that the writer had hitherto supposed that this species was given its name not from coloration, but in honor of Mr. E. E. Green !). The scale of *lateralis* differs in being grayish brown, a coloration derived from extraneous matter, and the species, as indicated in my former article, was described as a variety of Newsted's *diffinis* from immature specimens of *cydoniæ*. *Crawii* is separated because presenting a reddish gray coloration, which on examination is seen to come from the reddish bark of the plant carried up over the exterior of the scale as described in my former article.

Further comment is not needed, nor is it necessary to go beyond this single example, especially as this JOURNAL is not the most suitable place in which to undertake a revision of the entire group.

If all such careless and hasty work could be overlooked and ignored, little harm would result, but unfortunately these scale insects have many of them a considerable economic importance, and it is necessary to be able to determine them promptly and accurately. While it is possible for the care-free species-maker to sit down and, regardless of literature and type material, his own included, jauntily dash off, before breakfast perhaps, half a dozen new species and see them published the same week in the most accessible vehicle, it means unfortunately that someone else, if he be so favored as to get the type material and the description, has to spend hours perhaps with a microscope, dissecting needle, and drawing camera to determine finally that the insect described is an old and well-known species, or, in other words, what was five minutes' play for the heedless describer, causes the conscientious student, even under the most favorable conditions, several hours of real work.

One of the greatest evils complained of also is the complete disregard of proprieties and custom in the publishing of new species and new notes and facts regarding them in all sorts of out of the way and inappropriate places. 'The 20th Neotropical *Aspidiotus*,' published in a Chilian journal, may tickle the author's pride, but it adds very much to the difficulties of future students. Similarly new species and

varieties published as pamphlet brochures or as short papers in journals difficult or impossible of general access, as, for example, in such out-of-the-way places, from the standpoint of scientific literature, as Chile, Brazil, Jamaica, or Trinidad, are a positive detriment to science, because very few will ever be able to consult the original descriptions and very possibly the author himself often fails to receive a copy of them. This is all bad enough, but much worse is the use for publication of new species, or new facts and notes, of local daily or weekly journals of all sorts, such as *The Jamaica Post*, *Tri-Weekly Budget*, *Daily Gleaner*, *California Fruit Grower*, *Rio Grande Republican*, *Southwestern Farm and Orchard*, *Manhattan Kansas Industrialist*, *California State Board of Horticulture*, etc. In one number of the *California Fruit Grower*, for example, and none of the titles given are fanciful, no less than seven new species of scale insects are indicated, including *crawii* and *greenii*, noted above, and this as late as 1897.

This matter has been gone into perhaps already fully enough, and in fact the writer regrets the apparent necessity of continuing the discussion, hoping as he did that his first article would serve the needs of the case. If any 'running amuck' has been done, it is in the hasty publication of half-digested studies, as illustrated by the consideration of the single species given above.

C. L. Marlatt.

U. S. Department of Agriculture.

THE AMERICAN PHYSICAL SOCIETY.

The first regular meeting of this latest comer in the brotherhood of societies was held at Columbia University, Saturday, October 28th. A preliminary meeting in June elected officers and decided some details.

It is proposed to hold four meetings annually, simultaneously with the American Mathematical Society, which also meets at Columbia University. It is hoped that the two societies will coöperate and benefit each other. At the same time the new society is pledged to cooperate with Section B of the American Association for the Advancement of Science.

On Saturday last the mathematicians adjourned to hear the opening address by the President, Professor H. A. Rowland, who handled the great questions which confront the physicist of to-day in a most interesting manner and elicited frequent applause.

After business discussion several papers were presented.

Professor Rowland described experiments which failed to demonstrate an 'ether-wind' or a movement of the ether with moving matter, which would be of extreme interest if found.

Professor Pupin showed a method of rectifying alternating currents by an electrolytic cell and battery.

Professor Webster gave a semi-popular illustration of the propagation of an electromagnetic wave in the ether, and deduced the formulæ. He also showed and explained a curve-tracing top.

The meeting was eminently encouraging. Some thirty or forty working physicists were gathered together, representing fifteen or sixteen leading universities and colleges, and all seemed agreed that the new society was needed and would be a success.

The next meeting will be held at Columbia University between Christmas and New Year.

The present officers are: H. A. Rowland, president; A. A. Michelson, vice-president; Ernest Merritt, secretary; W. Hallock, Treasurer.

W. H.

SCIENTIFIC NOTES AND NEWS.

By the will of the late Judge Charles P. Daly, the American Geographical Society, New York, receives $5,000 for the founding of a medal to be given for distinguished geographical services.

A preliminary meeting of the members and fellows of the American Association for the Advancement of Science resident in or near New York City was held at Columbia University on October 24th, to make preliminary arrangements for the meeting of the Association to be held in New York during the last week in June, 1900. The business transacted included the election of an executive committee as follows: Professor J. J. Stevenson, Chairman, Professor J. McK. Cattell, secretary, Mr. Geo. F. Kunz, treasurer, Professor H. F. Osborn (entertainment), Professor N. L. Britton (excursions), Mr. C. F. Cox (transportation), and the general

officers of the Association resident in New York. Professor R. S. Woodward, president; Professor W. Hallock, secretary of the council; Professor J. F. Kemp, chairman of the geological section, and Dr. R. T. MacDougal, secretary of the botanical section.

Mr. O. F. COOK of the Division of Botany, Department of Agriculture, has been detailed to make a preliminary examination of the plant products of Puerto Rico with reference to the introduction of new and useful tropical plants into that island. Mr. Cook is accompanied by Mr. G. N. Collins of the Department of Agriculture as photographer, and by Mr. George P. Gall, who is sent by the Smithsonian Institution to collect material for the National Herbarium. The expedition left New York on October 28th by the United States transport MacPherson.

Mr. R. E. Snodgrass, assistant in entomology in Stanford University, and Mr. A. H. Heller, student in zoology, have just returned from a ten months collecting trip to the Galopagos Islands. The collections are large; birds, fish and insects and spiders being represented by especially large numbers of specimens. The collections belong to Stanford University under whose auspices the expedition was made.

PROFESSOR HENRY S. CARHART, of the department of physics of the University of Michigan, who is absent on leave, is at the Physical Technical Institute, Berlin. He is comparing the electromotive force of the standard Clark cell with that of the standard cell of the Institute.

THE following members of faculties of the University of Michigan, who were absent from the University last year on leave, have returned: Professor Volney M. Spalding, of the department of botany; Alexander Ziwet, junior professor of mathematics; George W. Patterson, junior professor of physics, and Perry F. Trowbridge, instructor in organic chemistry. During his absence abroad the degree of Ph.D. (Munich), was conferred on Professor Patterson. His thesis, which is entitled 'Eine Experimentelle und theoretische Untersuchung des Selbstpotentials,' is published in the October number of *Wiedemann's Annalen*, Leipzig.

PROFESSOR BALDWIN SPENCER has been appointed honorary director of the National Museum at Melbourne in succession to the late Sir Frederick M'Coy. The trustees of the Museum believe that it should be removed to a more central site.

THE Bradshaw lecture of the Royal College of Surgeons will be delivered by Mr. H. G. Howse, who will take as his subject 'A Centennial Review of Surgery.'

A LARGE and valuable collection of paintings of the fishes inhabiting the fresh and salt water about Japan is being exhibited in the museum of the University of Michigan. The collection was a present to the University by Frederick Stearns, of Detroit. The paintings are in water colors and are the work of a Japanese artist.

GRANTS have been made from the Moray endowment of the University of Edinburgh to Professor E. A. Schäfer for purposes of research on the central nervous system, and to Dr. John Malcolm for purposes of research on the alterations in bone marrow produced by nucleins and their allies.

DR. JAMES H. LEUBA, of Bryn Mawr College, has compiled a card catalogue of psychology containing about 10,000 titles. The catalogue consists of the contents of periodicals from 1860–1899. The periodicals selected are not confined to those devoted to psychology, but include many journals, such as *Nature*, the *American Journal of Science*, etc., in which psychological articles might be readily overlooked. There are, indeed, many journals omitted, such as the German physiological archives, but it is hoped that these may be indexed at some future time. Dr. Leuba offers to supply mimeographed copies of the catalogue on standard cards at a price not to exceed $50.00.

MR. W. A. SNOW, late instructor in entomology, in Stanford University, was drowned October 10th in San Francisco harbor. He was swept overboard from a small launch while greeting General Funston and the 20th Kansas Volunteers, just returned from Manila. Mr. Snow was a son of Chancellor F. H. Snow of the University of Kansas, and had been an instructor in entomology in the University of Kansas, the University of Illinois, and Stanford

University. He had published several systematic papers on the Diptera.

Professor J. B. Carnoy, of the Catholic University of Louvain, died at Schuls in the Engadine on the sixth of September. He was well known by his uncompleted manual of *Biologie cellulaire* and by his memoirs upon development of the sexual elements. He also founded the journal *La Cellule*. His writings were characterized by great lucidity but also by a marked positiveness and by a polemical tone which sometimes caused his assertions to be received with reserve. He was nevertheless an able and conscientious observer.

Mr. Grant Allen died on October 25th. He was born at Kingston, Ont., in 1848, and was well known, both for his writing on popular science, and more recently for his novels and other literary works. His books on 'Physiological Æsthetics' (1877) and the 'Color-Sense' (1879) promised serious contributions to science, and his work on the 'Evolution of the Idea of God' (1897) was an anthropological study of value, but most of his books and articles, which are extremely numerous, are of a popular character devoted especially to explaining the doctrine of evolution.

The date of the celebration of the centenary of the Royal College of Surgeons in England has been fixed for July 25th, 26th and 27th, 1900.

The National Geographic Society, Washington, announces the following lectures during November and December:

The popular course: November 3d, 'The Alaskan Boundary,' by Hon. John W. Foster; November 17th, 'Arctic Explorations in 1898–'99,' by Walter Wellman; December 1st, 'Glaciers of Alaska seen by the Harriman Expedition,' by Dr. G. K. Gilbert; December 8th, 'The Philippine Islands,' by Hon. John Barrett; December 15th, 'Natives of the Philippines,' by Professor Dean C. Worcester.

The technical course: November 10th, 'Tide-Levels of the Great Lakes,' by Mr. A. J. Henry; November 24th, 'Explorations in Patagonia,' by Mr. J. B. Hatcher; December 22d, 'Gila River and its Irrigation Possibilities,' by F. H. Newell.

Succeeding lectures for which partial arrangements have already been made will be announced on January 1st.

The *British Medical Journal* announces that during the coming session of the Pathological Society of London an important new departure will be made in regard to the meetings of this Society. Four of the fifteen meetings which have hitherto been held at the rooms of the Royal Medical and Chirurgical Society are to be held at different London laboratories, in connection or not, with medical schools, the object being that demonstrations may be given which it would be extremely difficult or impossible to carry out elsewhere. This is the realization of a proposal made some years ago by the late Professor Roy. It has, moreover, been determined that the report of an author's communication or demonstration given at any of the four laboratory meetings shall be made public only if the author himself so wish. The chief reason for this regulation is that the work being carried out at laboratories may be at such a stage of progress when brought forward that its publication would be premature and injudicious. The next meeting of the Society will be held at the Jenner Institute of Preventive Medicine on November 7th, and subsequent laboratory meetings will be held at University College, London (February 6th), at the Laboratories of the Royal Colleges of Physicians and Surgeons (March 6th), and at King's College (May 1st).

It is expected that the Chicago Drainage Canal, carrying the waters of Lake Michigan to the Illinois and Mississippi Rivers, will be open in December. It was constructed, in the first instance, to divert the sewage of Chicago from Lake Michigan, from which the city draws its water supply, but it may also be used as a ship canal, if the Illinois River is deepened, connecting Chicago and New Orleans. The canal is 35 miles in length, over 150 feet in width, and 20 feet deep, and has been constructed at a cost of about $30,000,000.

An Institute for the study of malaria has been established at Merv as a department of the St. Petersburg Institute of Experimental Medicine. The staff consists of a director with three assistants.

Nature states that in compliance with the request made by Russian men of science to the

Russian imperial authorities, the scientific exploration of the coast-line of the Pacific in the Far East is to be undertaken. It has been arranged that a distinguished zoologist and member of the Imperial Russian Geographical Society shall undertake the exploration at the cost of the Society, in conjunction with the Ministry of Agriculture. The expedition intends to make investigations with a view to classifying the marine fauna and flora on the coast of the Russian territory, and the conditions of zoological life will also be investigated upon the Liao-Tong peninsula, and in the adjacent regions of Manchuria and Korea. The period for these investigations has been fixed at two years, and the the cost of the expedition is estimated at 12,000 roubles. The Geographical Society has promised to make a grant of 7,500 roubles towards this sum, and the Ministry of Agriculture and Imperial Domains will contribute the remaining 4,500 roubles. The Ministry of Agriculture has been led to take a part in this expedition in the expectation that its results will be of great service in developing the coast industries of the Amur and the Island of Saghalien, and also in the districts which have been acquired lately by the Russian government. The Geographical Society also entertains great hopes of the successful results of this expedition, in view of the fact that the previous expeditions sent by it to investigate the Black, Azov and Marmora seas were particularly successful. The expedition to the Far East will work in conjunction with the Society for Exploring the Amur Territory, and intends to establish at Vladivostock a zoological station for studying the marine fauna of the district.

PROFESSOR J. MILNE writes to *Nature* that unusually large seismograms were obtained in the Isle of Wight on September 3d, 10th, 17th, 20th and 23d. The first three refer to disturbances originating in Alaska. The fourth refers to disasters in Asia Minor, and the last to an earthquake having an origin as distant as Japan. Since the 23d, in the Isle of Wight, and also at Kew, not the slightest movement has been recorded. The inference is that the great earthquakes reported as having taken place at Darjeeling on the night of September 25–26th are at the most small and local, and are not likely to have been recorded outside the Indian Peninsula. It is extremely likely that the tremors noticed in Darjeeling were due to landslides, and seismic phenomena were entirely absent.

UNIVERSITY AND EDUCATIONAL NEWS.

DR. BENJAMIN IDE WHEELER, recently professor of Greek in Cornell University, was inaugurated President of the University of California on October 25th. Addresses were made by President Jordan, of Stanford University; President Gilman of the Johns Hopkins University, and President Wheeler.

BY the will of the late Cornelius Vanderbilt, of New York, Yale University receives $100,000 and Vanderbilt University $50,000.

MR. CHARLES HOLCROFT has given £20,000 for the new Birmingham University. Other smaller gifts have also been announced, bringing the total endowment to £315,400. The endowment of Mason College of £200,000 will be transferred to the University, giving it a total endowment of over £500,000.

IT is proposed to enlarge the Durham University College of Science at a cost of £50,000. About £10,000 for this purpose was recently subscribed at a preliminary meeting.

THE attendance at Harvard University, not including Radcliffe College and the Summer School, is this year in all 4,067 students, an increase of 155 over last year. The numbers in the different classes and schools are as follows:

	1898–'99.	1899–'00.
Seniors	369	311
Juniors	335	351
Sophomores	508	507
Freshman	471	497
Specials	168	190
Totals	1,851	1,896
Science School	415	494
Graduate School	322	315
Divinity School	26	27
Law School	551	604
Medical School	560	550
Dental School	139	132
Veterinary School	25	24
Bussey Institution	23	25
Totals	3,912	4,067

THE registration at Columbia University is as follows:

	1898.	1899.
The College	387	439
Law School	342	369
Medical School	697	743
School of Applied Science	431	431
Faculties of Political Science, Philosophy and Pure Science,	262	256
Teachers College	234	272
Barnard College	257	258
	2610	2768

THE registration in the several departments of the University of Michigan is as follows:

Literary Department	1,279
Law Department	782
Medical D partment	469
Engineering Department	268
Dental Department	246
Pharmaceutical Department	75
Homœpathic Department	68
Total	3,187

IT is estimated that the total enrollment at Cornell University will this year be 3,000, as compared with 2,543 last year.

ACCORDING to the Allahabad *Pioneer Mail*, as quoted by *Nature*, during the past year, no fewer than 11,000 candidates presented themselves for the various examinations of the Madras University, and of these slightly over 4,000 were successful. The fees paid by candidates amounted to nearly Rs. 1,87,000; while sundry items, including about Rs. 10,000 interest on Government securities swelled the income of the University to a little over two lakhs of rupees. The total expenditure for the year came up to Rs. 1,80,000, of which sum Rs. 1,38,000 were absorbed by examiners' fees. The Arts Examinations, as usual, yielded the greatest portion of the University income—the total fees realized from candidates amounted to over one and a half lakhs of rupees, while payments to examiners came up to Rs. 90,000. The Law Examinations yielded a quarter of a lakh of rupees, while the examiner's fees only amounted to slightly over half this sum. The Medical and Engineering Examinations, however, are conducted at a loss; but, after balancing receipts and expenditures, the University realized a net profit during the past year of Rs. 10,000, without reckoning the Rs. 10,000 accruing as interest from Government securities.

AT Harvard University Mr. R. J. Forsythe has resigned his position as instructor in metallurgy, and his place has been taken by Mr. Albert Sauveur. C. H. White has been reappointed an assistant in mining. Mr. G. S. Rayner has been appointed to take charge of the mining laboratory.

CALEB Y. HARRISON, Ph.D. (Johns Hopkins, 1898), has been appointed professor of machine design in the University of Wisconsin.

FRANK B. SANBORN has been elected assistant professor of civil engineering at Tufts College.

THE new instructors and assistants in the several departments of chemistry of the University of Michigan are as follows: Eugene C. Sullivan, Ph.D., instructor in organic chemistry; George A. Hulett, Ph.D., instructor in general chemistry; Harrie N. Cole, assistant in qualitative chemistry; Fred L. Woods, assistant in quantitative chemistry; Norman F. Harriman, assistant in chemical technology; Harry M. Gordin, Ph.D., assistant in chemical research; Howard B. Bishop, laboratory assistant in chemistry; Arthur M. Lindauer, assistant in organic chemistry; Alfonso M. Clover, B.S., assistant in general chemistry, and George M. Heath, Ph.D., assistant in pharmacy. The title of Moses Gomberg, Sc.D., has been changed from instructor in organic chemistry to assistant professor in organic chemistry.

LORD ROSEBERY has been elected rector of Glasgow University by 829 votes to 515 votes cast for Lord Kelvin.

AT Cambridge University Mr. W. L. H. Duckworth, M.A., has been appointed to the University lectureship in physical anthropology.

ALFRED TINGLE, S.B. (London & Aberdeen), Ph.D. (University of Pennsylvania), has become instructor of chemistry in the University of Wisconsin.

DR. GUSTAV ROSCH has been appointed professor of electro-technology at the Technical School, at Aachen.

DR. SIGMUND FUCHS, assistant professor of physiology at the University of Vienna, has been appointed professor of the anatomy and physiology of domestic animals at the Agricultural Station, at Vienna.

ISAAC LEA.